

**SELECTIVE MELANIN CONCENTRATING HORMONE-1 (MCH1) RECEPTOR
ANTAGONISTS AND USES THEREOF**

BACKGROUND OF THE INVENTION

5 This application claims the benefit of U.S. Provisional
Application No. 60/216,218, filed July 5, 2000, the
contents of which are hereby incorporated by reference.

10 Throughout this application, various publications are
referenced in parentheses by author and year. Full
citations for these references may be found at the end of
the specification immediately preceding the sequence
listings and the claims. The disclosure of these
publications in their entireties are hereby incorporated by
15 reference into this application to describe more fully the
state of the art to which this invention pertains.

Melanin-concentrating hormone (MCH) is a cyclic peptide
originally isolated from salmonid (teleost fish)
20 pituitaries (Kawauchi et al., 1983). In fish the 17 amino
acid peptide causes aggregation of melanin within the
melanophores and inhibits the release of ACTH, acting as a
functional antagonist of α -MSH. Mammalian MCH (19 amino
acids) is highly conserved between rat, mouse, and human,
25 exhibiting 100% amino acid identity, but its physiological
roles are less clear. MCH has been reported to participate
in a variety of processes including feeding, water balance,
energy metabolism, general arousal/attention state, memory
and cognitive functions, and psychiatric disorders (for
30 reviews, see Baker, 1991; Baker, 1994; Nahon, 1994; Knigge
et al., 1996). Its role in feeding or body weight
regulation is supported by a recent *Nature* publication (Qu
et al., 1996) demonstrating that MCH is overexpressed in
the hypothalamus of *ob/ob* mice compared with *ob/+* mice, and

that fasting further increased MCH mRNA in both obese and normal mice during fasting. MCH also stimulated feeding in normal rats when injected into the lateral ventricles (Rossi et al., 1997). MCH also has been reported to functionally antagonize the behavioral effects of α -MSH (Miller et al., 1993; Gonzalez et al., 1996; Sanchez et al., 1997); in addition, stress has been shown to increase POMC mRNA levels while decreasing the MCH precursor preproMCH (ppMCH) mRNA levels (Presse et al., 1992). Thus MCH may serve as an integrative neuropeptide involved in the reaction to stress, as well as in the regulation of feeding and sexual activity (Baker, 1991; Knigge et al., 1996).

Although the biological effects of MCH are believed to be mediated by specific receptors, binding sites for MCH have not been well described. A tritiated ligand ($[^3\text{H}]$ -MCH) was reported to exhibit specific binding to brain membranes but was unusable for saturation analyses, so neither affinity nor B_{max} were determined (Drozdz and Eberle, 1995). Radioiodination of the tyrosine at position thirteen resulted in a ligand with dramatically reduced biological activity (see Drozdz and Eberle, 1995). In contrast, the radioiodination of the MCH analogue [$\text{Phe}^{13}, \text{Tyr}^{16}$]-MCH was successful (Drozdz et al., 1995); the ligand retained biological activity and exhibited specific binding to a variety of cell lines including mouse melanoma (B16-F1, G4F, and G4F-7), PC12, and COS cells. In G4F-7 cells, the $K_i = 0.118\text{nM}$ and the $B_{\text{max}} \sim 1100$ sites/cell. Importantly, the binding was not inhibited by α -MSH but was weakly inhibited by rat ANF ($K_i = 116\text{ nM}$ vs. 12 nM for native MCH) (Drozdz et al., 1995). More recently specific MCH binding was reported in transformed keratinocytes (Burgaud et al., 1997) and melanoma cells (Drozdz et al., 1998), where photo-crosslinking studies suggest that the receptor is a membrane protein with an apparent molecular weight of 45-50

kDaltons, compatible with the molecular weight range of the GPCR superfamily of receptors. No radioautoradiographic studies of MCH receptor localization using this ligand have been reported as yet.

5

The localization and biological activities of MCH peptide suggest that the modulation of MCH receptor activity may be useful in a number of therapeutic applications. The role of MCH in feeding is the best characterized of its potential clinical uses. MCH is expressed in the lateral hypothalamus, a brain area implicated in the regulation of thirst and hunger (Grillon et al., 1997); recently orexins A and B, which are potent orexigenic agents, have been shown to have very similar localization to MCH in the lateral hypothalamus (Sakurai et al., 1998). MCH mRNA levels in this brain region are increased in rats after 24 hours of food-deprivation (Hervé and Fellman, 1997); after insulin injection, a significant increase in the abundance and staining intensity of MCH immunoreactive perikarya and fibres was observed concurrent with a significant increase in the level of MCH mRNA (Bahjaoui-Bouhaddi et al., 1994). Consistent with the ability of MCH to stimulate feeding in rats (Rossi et al., 1997) is the observation that MCH mRNA levels are upregulated in the hypothalami of obese *ob/ob* mice (Qu et al., 1996), and decreased in the hypothalami of rats treated with leptin, whose food intake and body weight gains are also decreased (Sahu, 1998). MCH appears to act as a functional antagonist of the melanocortin system in its effects on food intake and on hormone secretion within the HPA (hypothalamopituitary/adrenal axis) (Ludwig et al., 1998). Together these data suggest a role for endogenous MCH in the regulation of energy balance and response to stress, and provide a rationale for the development of specific compounds acting at MCH receptors for use in the treatment of obesity and stress-related disorders.

10

15

20

25

30

35

In all species studied to date, a major portion of the neurons of the MCH cell group occupies a rather constant location in those areas of the lateral hypothalamus and subthalamus where they lie and may be a part of some of the so-called "extrapyramidal" motor circuits. These involve substantial striato- and pallidofugal pathways involving the thalamus and cerebral cortex, hypothalamic areas, and reciprocal connections to subthalamic nucleus, substantia nigra, and mid-brain centers (Bittencourt et al., 1992). In their location, the MCH cell group may offer a bridge or mechanism for expressing hypothalamic visceral activity with appropriate and coordinated motor activity. Clinically it may be of some value to consider the involvement of this MCH system in movement disorders, such as Parkinson's disease and Huntingdon's Chorea in which extrapyramidal circuits are known to be involved.

Human genetic linkage studies have located authentic hMCH loci on chromosome 12 (12q23-24) and the variant hMCH loci on chromosome 5 (5q12-13) (Pedeutour et al., 1994). Locus 12q23-24 coincides with a locus to which autosomal dominant cerebellar ataxia type II (SCA2) has been mapped (Auburger et al., 1992; Twells et al., 1992). This disease comprises neurodegenerative disorders, including an olivopontocerebellar atrophy. Furthermore, the gene for Darier's disease, has been mapped to locus 12q23-24 (Craddock et al., 1993). Darier's disease is characterized by abnormalities in keratinocyte adhesion and mental illnesses in some families. In view of the functional and neuroanatomical patterns of the MCH neural system in the rat and human brains, the MCH gene may represent a good candidate for SCA2 or Darier's disease. Interestingly, diseases with high social impact have been mapped to this locus. Indeed, the gene responsible for chronic or acute

forms of spinal muscular atrophies has been assigned to chromosome 5q12-13 using genetic linkage analysis (Melki et al., 1990; Westbrook et al., 1992). Furthermore, independent lines of evidence support the assignment of a major schizophrenia locus to chromosome 5q11.2-13.3 (Sherrington et al., 1988; Bassett et al., 1988; Gilliam et al., 1989). The above studies suggest that MCH may play a role in neurodegenerative diseases and disorders of emotion.

Additional therapeutic applications for MCH-related compounds are suggested by the observed effects of MCH in other biological systems. For example, MCH may regulate reproductive functions in male and female rats. MCH transcripts and MCH peptide were found within germ cells in testes of adult rats, suggesting that MCH may participate in stem cell renewal and/or differentiation of early spermatocytes (Hervieu et al., 1996). MCH injected directly into the medial preoptic area (MPOA) or ventromedial nucleus (VMN) stimulated sexual activity in female rats (Gonzalez et al., 1996). In ovariectomized rats primed with estradiol, MCH stimulated luteinizing hormone (LH) release while anti-MCH antiserum inhibited LH release (Gonzalez et al., 1997). The zona incerta, which contains a large population of MCH cell bodies, has previously been identified as a regulatory site for the pre-ovulatory LH surge (MacKenzie et al., 1984). MCH has been reported to influence release of pituitary hormones including ACTH and oxytocin. MCH analogues may also be useful in treating epilepsy. In the PTZ seizure model, injection of MCH prior to seizure induction prevented seizure activity in both rats and guinea pigs, suggesting that MCH-containing neurons may participate in the neural circuitry underlying PTZ-induced seizure (Knigge and Wagner, 1997). MCH has also been observed to affect

behavioral correlates of cognitive functions. MCH treatment hastened extinction of the passive avoidance response in rats (McBride et al., 1994), raising the possibility that MCH receptor antagonists may be beneficial for memory storage and/or retention. A possible role for MCH in the modulation or perception of pain is supported by the dense innervation of the periaqueductal grey (PAG) by MCH-positive fibers. Finally, MCH may participate in the regulation of fluid intake. ICV infusion of MCH in conscious sheep produced diuretic, natriuretic, and kaliuretic changes in response to increased plasma volume (Parkes, 1996). Together with anatomical data reporting the presence of MCH in fluid regulatory areas of the brain, the results indicate that MCH may be an important peptide involved in the central control of fluid homeostasis in mammals.

As used in this invention, the term "antagonist" refers to a compound which binds to, and decreases the activity of, a receptor in the presence of an agonist. In the case of a G-protein coupled receptor, activation may be measured using any appropriate second messenger system which is coupled to the receptor in a cell or tissue in which the receptor is expressed. Some specific, but by no means limiting, examples of well-known second messenger systems are adenylate cyclase, intracellular calcium mobilization, ion channel activation, guanylate cyclase and inositol phospholipid hydrolysis. Conversely, the term "agonist" refers to a compound which binds to, and increases activity of, a receptor as compared with the activity of the receptor in the absence of any agonist.

In one embodiment of this invention, the synthesis of novel compounds which bind selectively to the cloned human melanin-concentrating hormone-1 (MCH1) receptor, compared

to other cloned G-protein coupled receptors, and inhibit the activation of the cloned receptors as measured in in vitro assays is disclosed. The in vitro receptor binding and activation assays described hereinafter were performed using various cultured cell lines, each transfected with and expressing only a single cloned receptor.

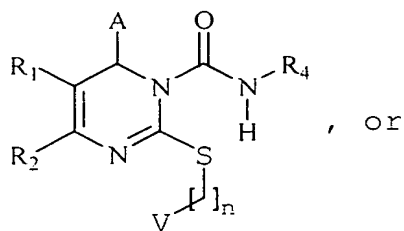
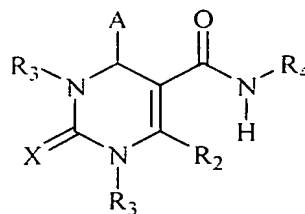
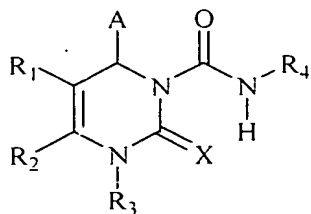
Furthermore, the compounds of the present invention may also be used to treat abnormal conditions such as feeding disorders (obesity, bulimia and bulimia nervosa), sexual/reproductive disorders, depression, anxiety, depression and anxiety, epileptic seizure, hypertension, cerebral hemorrhage, congestive heart failure, sleep disturbances, or any condition in which antagonism of an MCH1 receptor may be beneficial. In addition, the compounds of the present invention may be used to reduce the body mass of a subject.

Summary Of The Invention

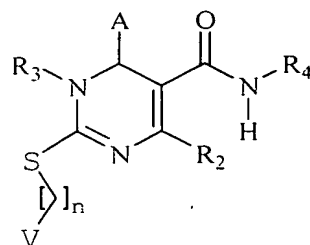
This invention provides a compound having the structure:

5

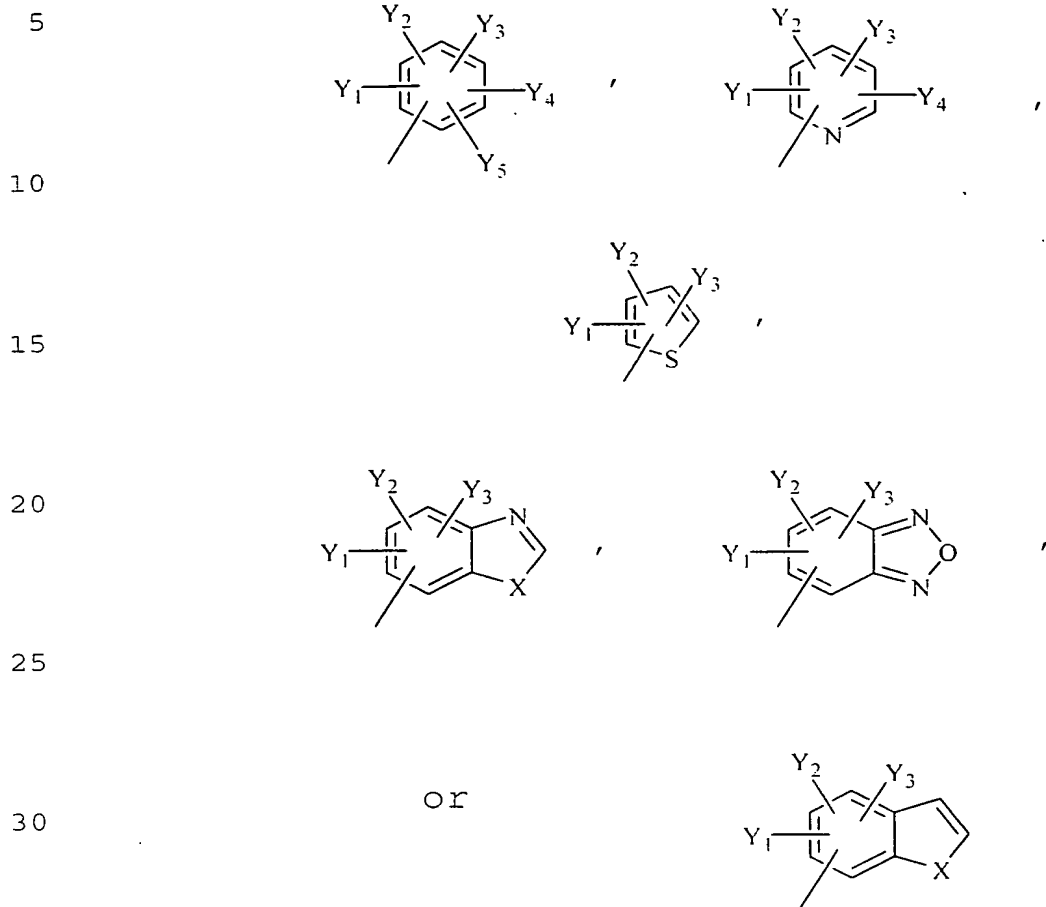
10



, or



wherein A is



wherein each of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -F, -Cl, -Br, or -I; - NO_2 ; - N_3 ; -CN; - OR_3 , - $OCOR_3$, - COR_3 , - $CON(R_3)_2$, or - $COOR_3$; or any two of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 present on adjacent carbon atoms can constitute a methylenedioxy group;

wherein each X is independently S; O; or NR_3 ;

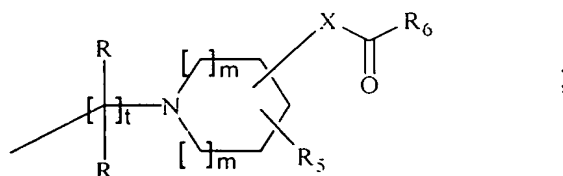
wherein R_1 is -H; $-NO_2$; $-CN$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; $-CON(R_3)_2$; or $-CO_2(CH_2)_nV$;

wherein R_2 is -H; straight chained or branched C_1 - C_7 alkyl, hydroxyalkyl, alkoxyalkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; C_3 - C_{10} cycloalkyl- C_1 - C_{10} -alkyl, C_3 - C_{10} cycloalkyl- C_1 - C_{10} -monofluoroalkyl or C_3 - C_{10} cycloalkyl- C_1 - C_{10} -polyfluoroalkyl; $-CN$; $-CH_2XR_3$, $-CH_2X(CH_2)_pNHR_3$, $-(CH_2)_nNHR_3$, $-CH_2X(CH_2)_pN(R_3)_2$, $-CH_2X(CH_2)_pN_3$, $-CH_2X(CH_2)_pNHCXR_7$; or $-OR_3$; or wherein R_1 and R_2 together may form a lactone ring;

wherein each R_3 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

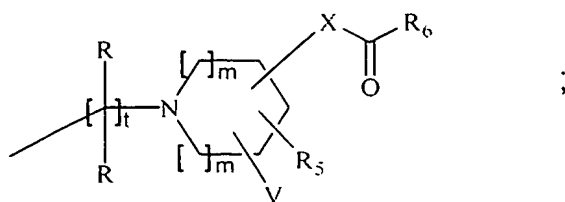
wherein R_4 is

(i)



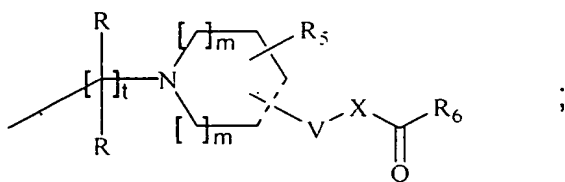
(iii)

5



(iii)

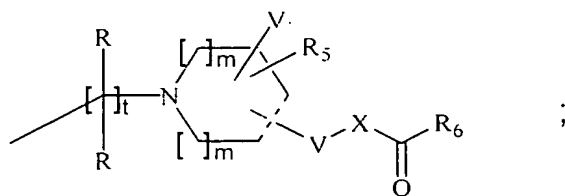
10



15

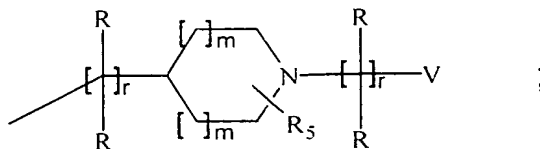
(iv)

20



25

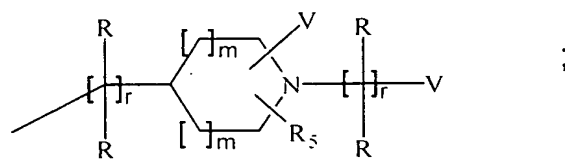
(v)



30

(vi)

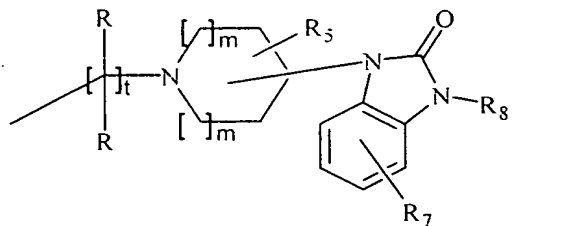
35



40

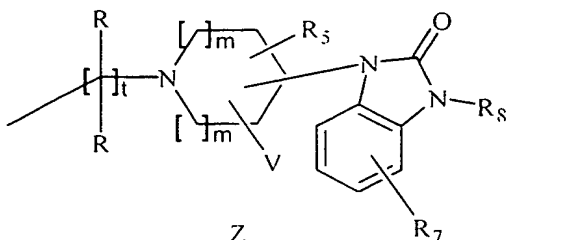
(vii)

45



(viii)

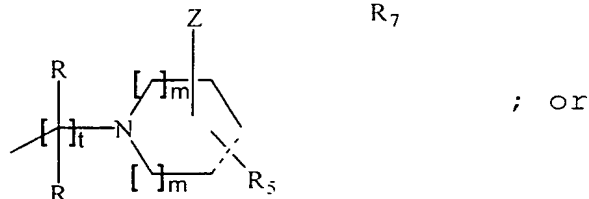
5



10

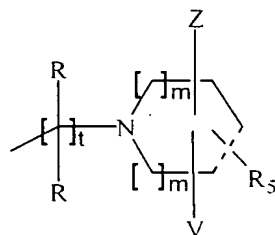
(ix)

15



(x)

20



25

wherein the dashed line represents a single bond or a double bond;

30

wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or -CON(R₃)₂;

35

wherein each V is independently aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

40

wherein each R_5 is -H; $-NO_2$; $-N_3$; $-CN$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; $-CON(R_3)_2$; aryl or heteroaryl, wherein the aryl or heteroaryl is optionally substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C_2 - C_7 alkenyl, C_2 - C_7 alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein R_6 is -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; $-CON(R_3)_2$; aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C_2 - C_7 alkenyl, C_2 - C_7 alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein R_7 is H; F; Cl; Br; I; $-NO_2$; $-N_3$; $-CN$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or

-CON(R₃)₂;

wherein R₈ is independently straight chained or branched
C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight
5 chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇
cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein Z is naphthyl, quinolinyl, isoquinolinyl,
10 quinazolinyl, phthalazinyl, quinoxalinyl, indolyl,
benzo[b]furanyl, or benzo[b]thiophenyl; wherein the
naphthyl, quinolinyl, isoquinolinyl, quinazolinyl,
phthalazinyl, quinoxalinyl, indolyl, benzo[b]furanyl, or
benzo[b]thiophenyl may be substituted with one or more F;
15 Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃;
-SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched
C₁-C- alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl,
or carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
20 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein each m is independently an integer from 0 to 3
inclusive;

25 wherein each n is independently an integer from 0 to 5
inclusive;

wherein each p is independently an integer from 1 to 7
30 inclusive;

wherein q is an integer from 1 to 3 inclusive;

wherein r is an integer from 0 to 3 inclusive;

35

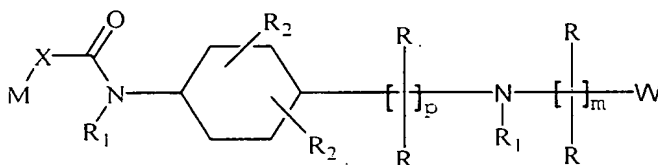
wherein t is an integer from 2 to 6 inclusive;

or a pharmaceutically acceptable salt thereof.

5

This invention further provides a compound having the structure:

10



15

wherein each R is independently $-H$; $-F$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2-C_7 alkenyl or alkynyl; $-N(R_3)_2$; $-NO_2$; $-CN$; $-SR_3$; $-CO_2R_3$; or $-OR_3$;

20

wherein each R_1 is independently $-H$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$;

25

wherein each R_2 is $-H$; $-NO_2$; $-N_3$; $-CN$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$; or aryl or heteroaryl, optionally substituted with one or more F ; Cl ; Br ; I ; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched C_1-C_7 alkyl,

35

monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
5 cycloalkenyl;

wherein each R₃ is independently -H; straight chained or
branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
10 C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl;

wherein M is aryl or heteroaryl, optionally substituted
with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN;
15 -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight
chained or branched C₁-C₇ alkyl, monofluoroalkyl,
polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl;
straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl;
C₃-C₇ cycloalkyl, monofluorocycloalkyl,
20 polyfluorocycloalkyl or cycloalkenyl;

wherein X is (CH₂)_n, O, S or NR₃;

wherein W is

25

(a) C₃-C₇ cycloalkyl, monofluorocycloalkyl,
polyfluorocycloalkyl or cycloalkenyl optionally
substituted with one or more COR₃; CO₂R₃; -CON(R₃)₂;
CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃;
30 straight chained or branched C₁-C₇ alkyl,
monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl; or

35

(b) aryl or heteroaryl optionally substituted with one

or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN;
 -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃;
 straight chained or branched C₁-C₇ alkyl,
 monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
 5 carboxamidoalkyl; straight chained or branched C₁-C₇
 alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl;

wherein m is an integer from 0 to 4 inclusive;

10 wherein n is an integer from 0 to 6 inclusive;

wherein p is an integer from 1 to 4 inclusive;

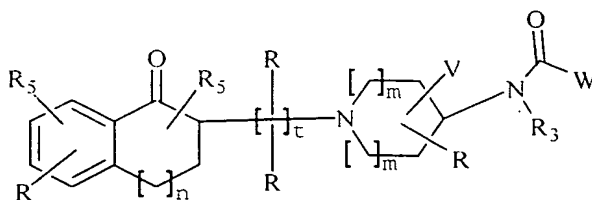
wherein q is an integer from 1 to 3 inclusive;

15

or a pharmaceutically acceptable salt thereof.

This invention also provides a compound having the
 structure:

20



25

wherein each R is independently -H; -F; straight chained
 or branched C₁-C₇ alkyl, monofluoroalkyl or
 polyfluoroalkyl; straight chained or branched C₂-C₇
 30 alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or
 -CON(R₃)₂;

wherein each R₁ is independently -H; F; Cl; Br; I; -NO₂;
 -N₃; -CN; straight chained or branched C₁-C₇ alkyl,
 35 monofluoroalkyl or polyfluoroalkyl; straight chained or
 branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl,
 monofluorocycloalkyl, polyfluorocycloalkyl or

cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$;
 $-CON(R_3)_2$; aryl or heteroaryl, wherein the aryl or
heteroaryl is optionally substituted with one or more F;
Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$;
5 $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched
 C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl,
or carboxamidoalkyl; straight chained or branched C_2-C_7 -
alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
10 cycloalkenyl;

wherein each R_3 is independently -H; straight chained or
branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 -
15 C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl;

wherein R_5 is -H; $-NO_2$; $-N_3$; -CN; straight chained or
branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl;
20 straight chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 -
 C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$;
 $-CON(R_3)_2$; aryl or heteroaryl, wherein the aryl or
heteroaryl is optionally substituted with one or more F;
25 Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$;
 $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched
 C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl,
or carboxamidoalkyl; straight chained or branched C_2-C_7 -
alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl,
30 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein V is H; aryl or heteroaryl, optionally
substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ;
35 $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$;

$(\text{CH}_2)_q\text{SR}_3$; straight chained or branched $\text{C}_1\text{-C}_7$ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched $\text{C}_2\text{-C}_7$ alkenyl, $\text{C}_2\text{-C}_7$ alkynyl; $\text{C}_3\text{-C}_7$ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein W is

- 10 (a) $\text{C}_3\text{-C}_7$ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl optionally substituted with one or more COR_3 ; CO_2R_3 ; $-\text{CON}(\text{R}_3)_2$; CN ; $-\text{NO}_2$; $-\text{N}(\text{R}_3)_2$; $-\text{OR}_3$; $-\text{SR}_3$; $(\text{CH}_2)_q\text{OR}_3$; $(\text{CH}_2)_q\text{SR}_3$; straight chained or
- 15 branched $\text{C}_1\text{-C}_7$ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched $\text{C}_2\text{-C}_7$ alkenyl, $\text{C}_2\text{-C}_7$ alkynyl; $\text{C}_3\text{-C}_7$ cycloalkyl; or
- 20 (b) aryl or heteroaryl optionally substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-\text{CON}(\text{R}_3)_2$; CN ; $-\text{NO}_2$; $-\text{N}(\text{R}_3)_2$; $-\text{OR}_3$; $-\text{SR}_3$; $(\text{CH}_2)_q\text{OR}_3$; $(\text{CH}_2)_q\text{SR}_3$; straight chained or branched $\text{C}_1\text{-C}_7$
- 25 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched $\text{C}_2\text{-C}_7$ alkenyl, $\text{C}_2\text{-C}_7$ alkynyl; $\text{C}_3\text{-C}_7$ cycloalkyl;

30 wherein each m is independently an integer from 0 to 3 inclusive;

wherein n is an integer from 0 to 2 inclusive;

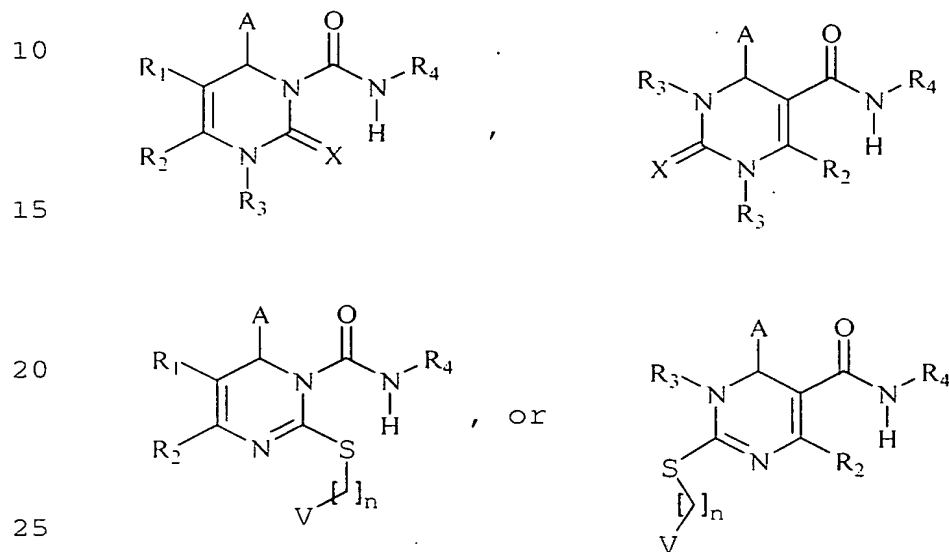
35 wherein p is an integer from 1 to 7 inclusive;

wherein q is an integer from 1 to 3 inclusive;

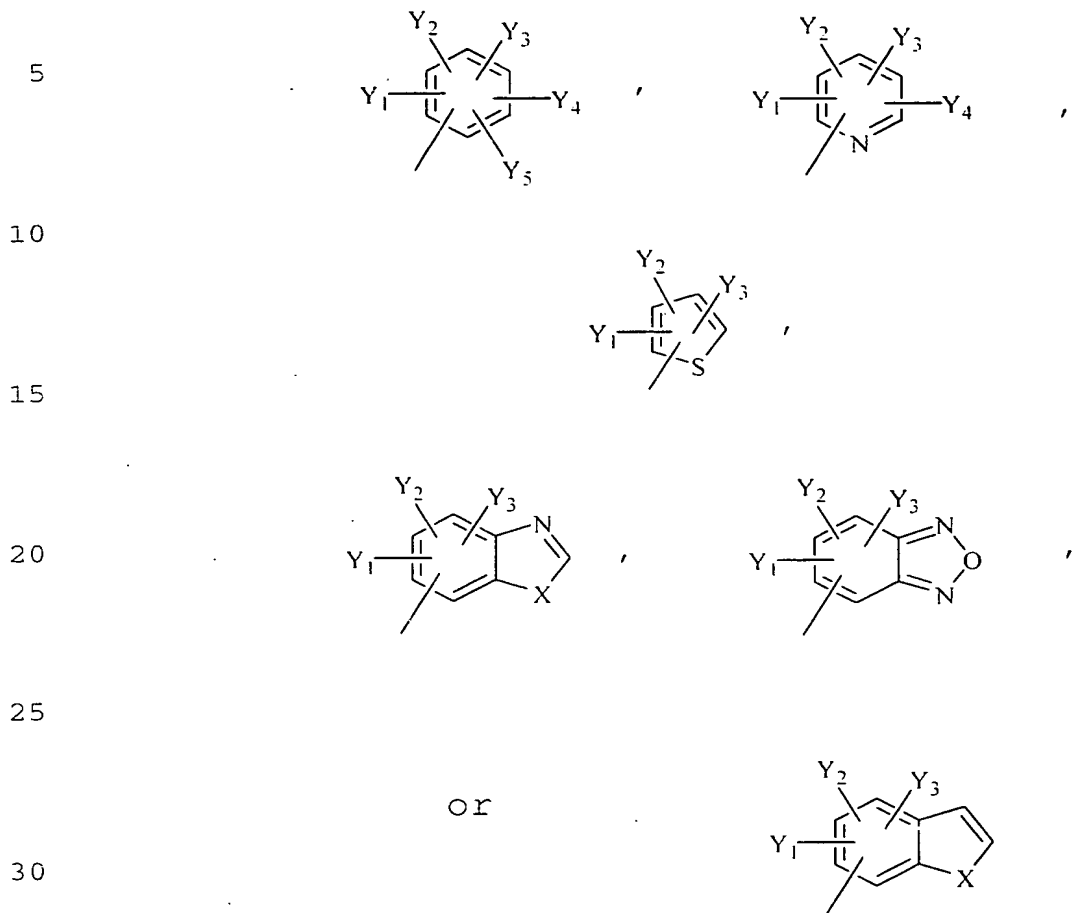
wherein t is an integer from 2 to 6 inclusive;

5 or a pharmaceutically acceptable salt thereof.

This invention further provides a method of modifying feeding behavior of a subject which comprises administering to the subject an amount of a compound effective to decrease the consumption of food by the subject wherein the compound has the structure:



wherein A is



wherein each of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -F, -Cl, -Br, or -I; - NO_2 ; - N_3 ; -CN; - OR_3 , - $OCOR_3$, - COR_3 , - $CON(R_3)_2$, or - $COOR_3$;
 40 or any two of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 present on adjacent carbon atoms can constitute a methylenedioxy group;

wherein each X is independently S; O; or NR_3 ;

45 wherein R_1 is -H; - NO_2 ; -CN; straight chained or branched

C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight
chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇
cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
5 -CON(R₃)₂; or CO₂(CH₂)_nV;

wherein R₂ is -H; straight chained or branched C₁-C₇
alkyl, hydroxyalkyl, alkoxyalkyl, aminoalkyl,
monofluoroalkyl or polyfluoroalkyl; straight chained or
10 branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl; C₃-C₁₀ cycloalkyl-C₁-C₁₀-alkyl, C₃-C₁₀
cycloalkyl-C₁-C₁₀-monofluoroalkyl or C₃-C₁₀ cycloalkyl-C₁-
C₁₀-polyfluoroalkyl; -CN; -CH₂XR₃, -CH₂X(CH₂)_pNHR₃,
15 -(CH₂)_nNHR₃, -CH₂X(CH₂)_pN(R₃)₂, -CH₂X(CH₂)_pN₃,
-CH₂X(CH₂)_pNHCXR₅; -OR₃; or wherein R₁ and R₂ together form
a lactone ring;

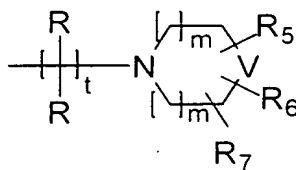
wherein each R₃ is independently -H; straight chained or
20 branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl;

25

wherein R_4 is

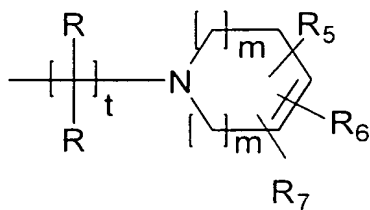
(i)

5



(ii)

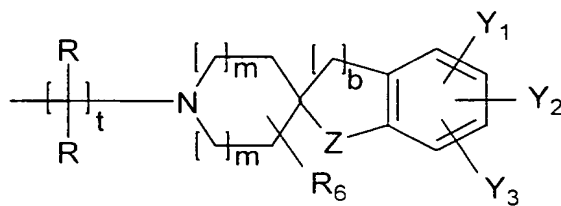
10



15

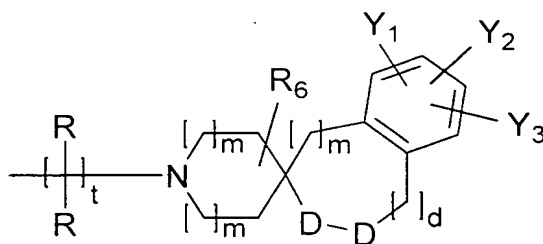
(iii)

20



(iv)

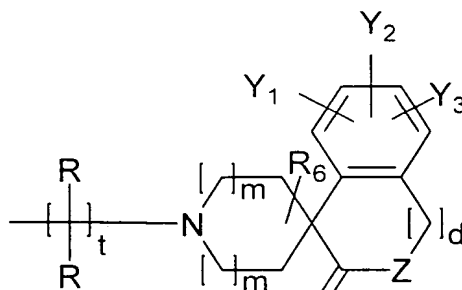
25



30

(v)

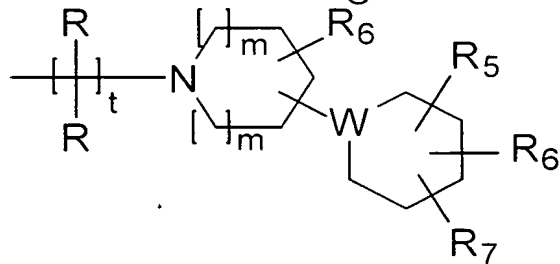
35



40

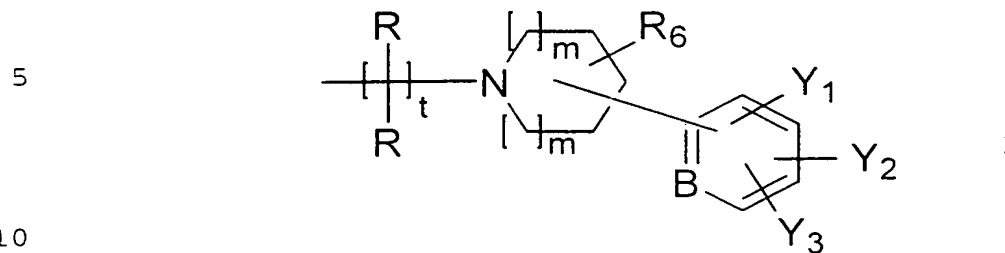
(vi)

45

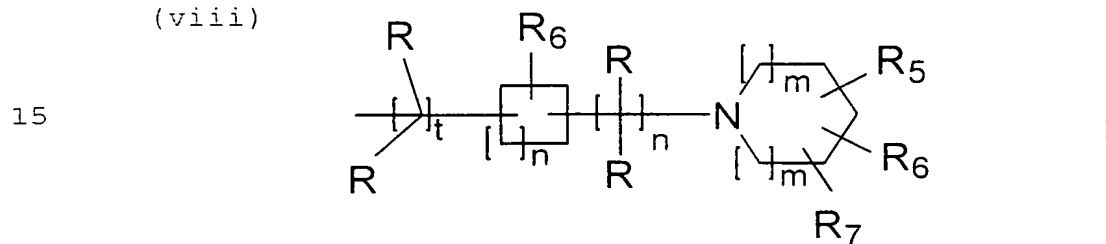


50

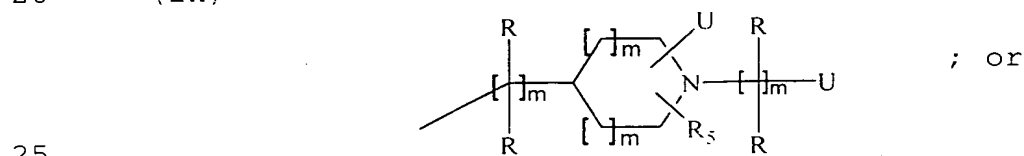
(vii)



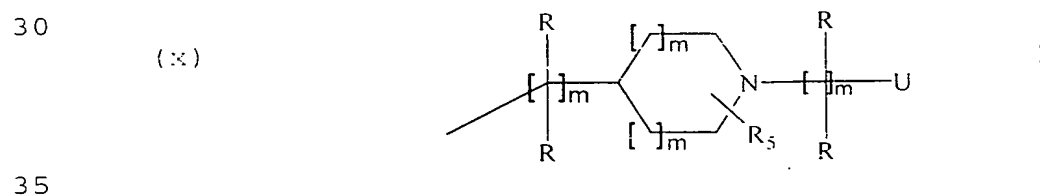
(viii)



(ix)



(x)



wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or -CN(R₃)₂;

wherein B is N or CY₄;

wherein each D is independently C(R₃)₂; O; S; NR₃; CO; or CS;

wherein each U is independently aryl or heteroaryl,
optionally substituted with one or more F; Cl; Br; I;
COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃;
(CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C-
5 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

10

wherein V is C(R₅)₂; CR₅R₆; NR₅ or NR₆;

wherein W is CR₅; CR₆ or N;

15

wherein Z is S; O; C(R₃)₂; or NR₃;

wherein each R₅ is -H; -NO₂; -N₃; -CN; straight chained or
branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
20 C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
or -CON(R₃)₂; -XCOR₈; or aryl or heteroaryl, wherein the
aryl or heteroaryl is optionally substituted with one or
more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂;
25 -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; -XCOR₈; straight
chained or branched C₁-C₇ alkyl, monofluoroalkyl,
polyfluoroalkyl, or aminoalkyl; straight chained or
branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
30 cycloalkenyl;

wherein each R₆ is independently -H; straight chained or
branched C₁-C₇ alkyl, hydroxyalkyl, aminoalkyl,
alkoxyalkyl, monofluoroalkyl or polyfluoroalkyl; straight
35 chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇

cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$;

5 wherein R_7 is -H; aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; $-XCOR_3$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, or aminoalkyl;
10 straight chained or branched C_2-C_7 alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein R_8 is -H; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight
15 chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$; aryl or heteroaryl, optionally substituted with
20 one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or
25 branched C_2-C_7 alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein b is 1 or 2;

30 wherein d is an integer from 0 to 2 inclusive;

wherein each m is independently an integer from 0 to 3 inclusive;

35 wherein each n is independently an integer from 0 to 5

inclusive;

wherein each p is independently an integer from 1 to 7
inclusive;

5

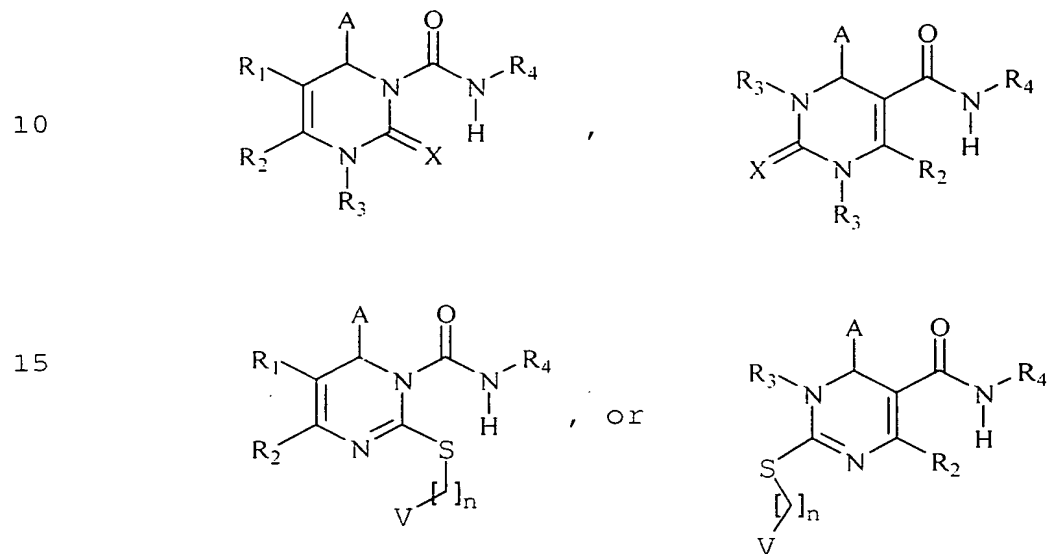
wherein q is an integer from 1 to 3 inclusive;

wherein t is an integer from 2 to 6 inclusive;

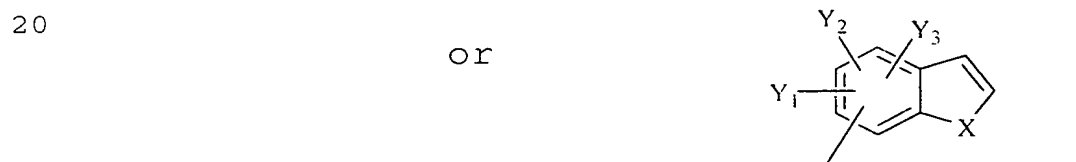
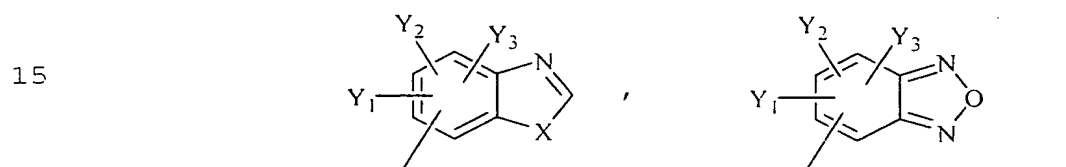
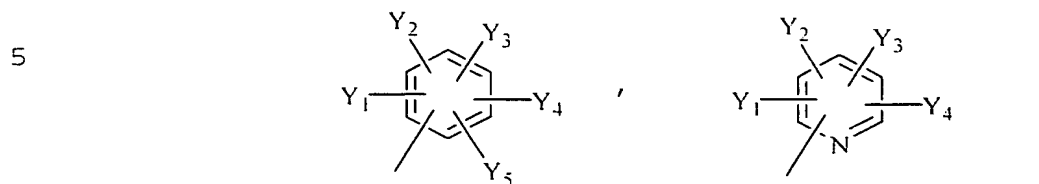
10

or a pharmaceutically acceptable salt thereof.

This invention further provides a method of reducing the body mass of a subject which comprises administering to the subject an amount of a compound effective to reduce the body mass of the subject wherein the compound has the structure:



wherein A is



wherein each of Y₁, Y₂, Y₃, Y₄ and Y₅ is independently -H;
 25 straight chained or branched C₁-C₇ alkyl, monofluoroalkyl
 or polyfluoroalkyl; straight chained or branched C₂-C₇
 alkenyl or alkynyl; C₃-C₇ cycloalkyl,
 monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; -F, -Cl, -Br, or -I;
 30 -NO₂; -N₃; -CN; -OR₃, -OCOR₃, -COR₃, -CON(R₃)₂, or -COOR₃;
 or any two of Y₁, Y₂, Y₃, Y₄ and Y₅ present on adjacent
 carbon atoms can constitute a methylenedioxy group;

wherein each X is independently S; O; or NR₃;

wherein R_1 is -H; -NO₂; -CN; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; -CON(R₃)₂; or CO₂(CH₂)_nV;

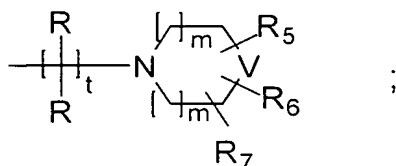
wherein R_2 is -H; straight chained or branched C₁-C₇ alkyl, hydroxyalkyl, alkoxyalkyl, aminoalkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; C₃-C₁₀ cycloalkyl-C₁-C₁₀-alkyl, C₃-C₁₀ cycloalkyl-C₁-C₁₀-monofluoroalkyl or C₃-C₁₀ cycloalkyl-C₁-C₁₀-polyfluoroalkyl; -CN; -CH₂XR₃, -CH₂X(CH₂)_pNHR₃, -(CH₂)_nNHR₃, -CH₂X(CH₂)_pN(R₃)₂, -CH₂X(CH₂)_pN₃, -CH₂X(CH₂)_pNHCXR₅; -OR₃; or wherein R_1 and R_2 together form a lactone ring;

wherein each R_3 is independently -H; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein R_4 is

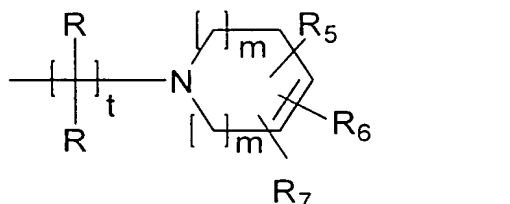
(i)

30



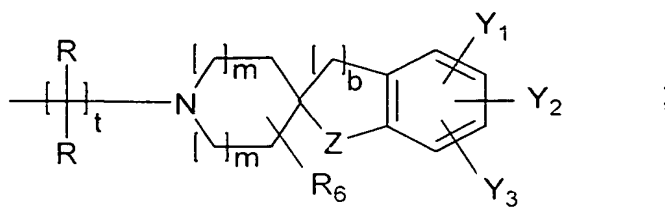
(ii)

35



(iii)

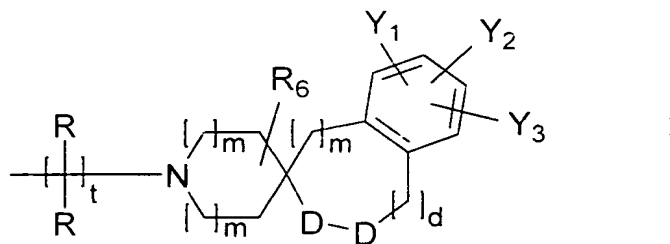
5



10

(iv)

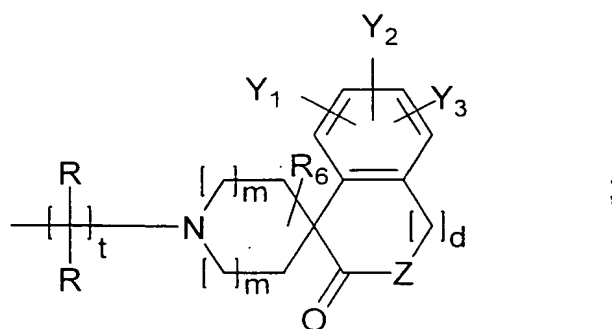
15



20

(v)

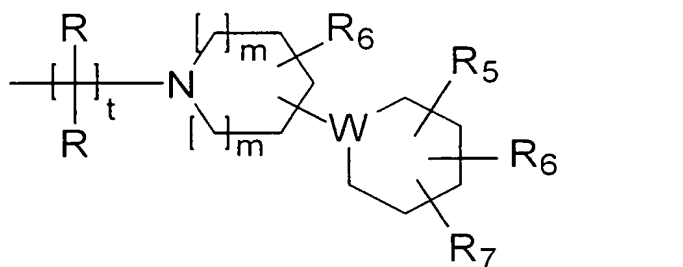
25



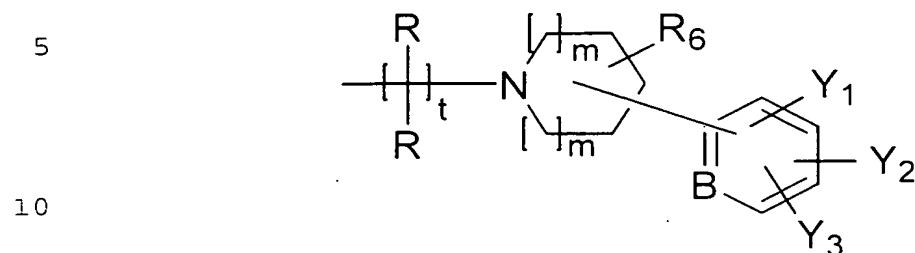
30

(vi)

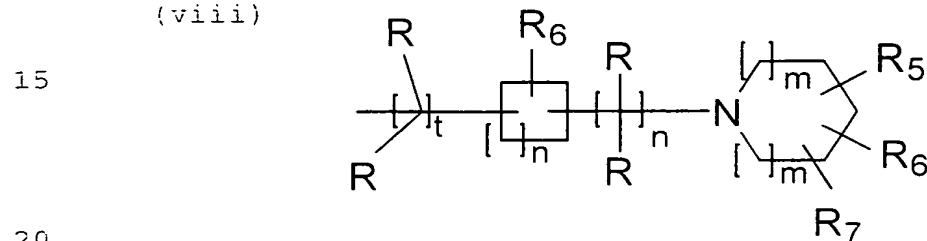
35



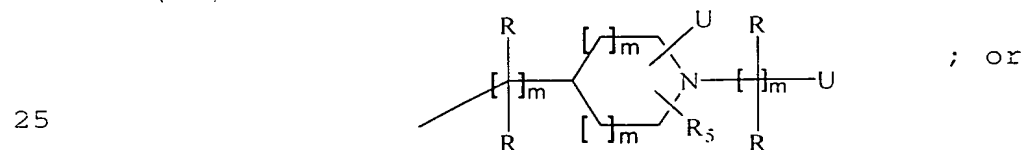
(vii)



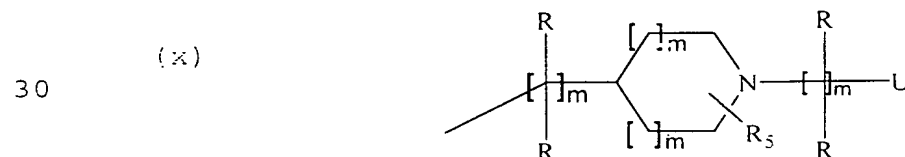
(viii)



(ix)



(x)



35

wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or

40 -CN(R₃)₂;

wherein B is N or CY₄;

wherein each D is independently C(R₃)₂; O; S; NR₃; CO; or

45 CS;

wherein each U is independently aryl or heteroaryl,
optionally substituted with one or more F; Cl; Br; I;
COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃;
(CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C-
5 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

10 wherein V is C(R₅)₂; CR₅R₆; NR₅ or NR₆;

wherein W is CR₅; CR₆ or N;

15 wherein Z is S; O; C(R₃)₂; or NR₃;

wherein each R₅ is -H; -NO₂; -N₃; -CN; straight chained or
branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₁-
20 C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
or -CON(R₃)₂; -XCOR₈; or aryl or heteroaryl, wherein the
aryl or heteroaryl is optionally substituted with one or
more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂;
25 -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; -XCOR₈; straight
chained or branched C₁-C₇ alkyl, monofluoroalkyl,
polyfluoroalkyl, or aminoalkyl; straight chained or
branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
30 cycloalkenyl;

wherein each R₆ is independently -H; straight chained or
branched C₁-C₇ alkyl, hydroxyalkyl, aminoalkyl,
alkoxyalkyl, monofluoroalkyl or polyfluoroalkyl; straight
35 chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇

cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$;

5 wherein R_7 is $-H$; aryl or heteroaryl, optionally substituted with one or more F ; Cl ; Br ; I ; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; $-XCOR_8$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, or aminoalkyl;
10 straight chained or branched C_2-C_7 alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

15 wherein R_8 is $-H$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or $-CON(R_3)_2$; aryl or heteroaryl, optionally substituted with
20 one or more F ; Cl ; Br ; I ; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C_2-C_7 alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl,
25 monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein b is 1 or 2;

30 wherein d is an integer from 0 to 2 inclusive;

wherein each m is independently an integer from 0 to 3 inclusive;

35 wherein each n is independently an integer from 0 to 5

inclusive;

wherein each p is independently an integer from 1 to 7
inclusive;

5

wherein q is an integer from 1 to 3 inclusive;

wherein t is an integer from 2 to 6 inclusive;

10

or a pharmaceutically acceptable salt thereof.

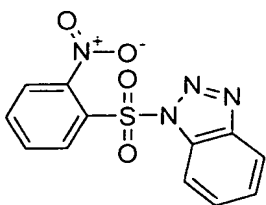
15

In addition, the present invention provides a method of
treating a subject suffering from depression and/or
anxiety which comprises administering to the subject a
compound of the aforementioned formula in an amount
effective to treat the subject's depression and/or
anxiety.

20

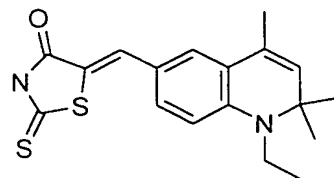
This invention also provides a method of modifying
feeding behavior of a subject which comprises
administering to the subject an amount of a compound
effective to decrease the consumption of food by the
subject wherein the compound is selected from the group
consisting of:

a)



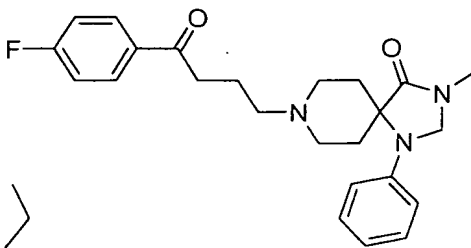
;

(b)



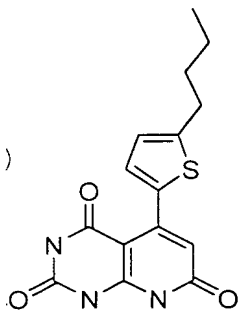
;

c)



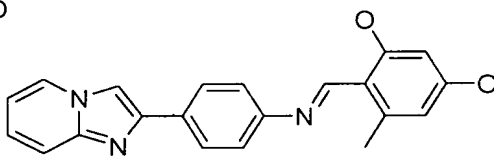
;

d)



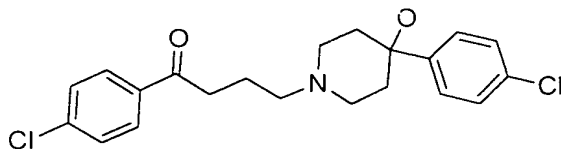
;

e)



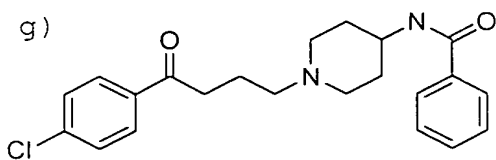
;

f)

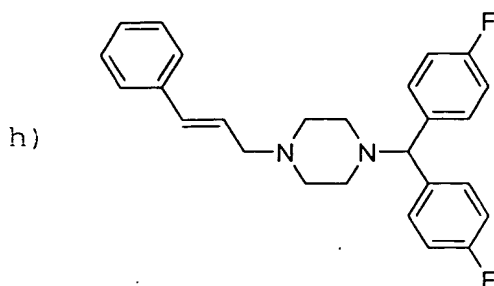


;

g)



; and



This invention further provides a method of treating a feeding disorder in a subject which comprises administering to the subject an amount of a compound of the invention effective to decrease the consumption of food by the subject.

This invention also provides a pharmaceutical composition comprising a therapeutically effective amount of the compound of the invention and a pharmaceutically acceptable carrier.

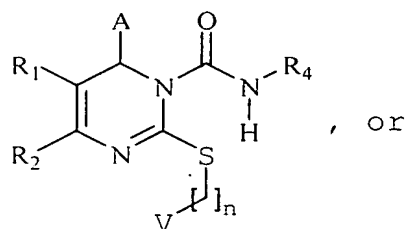
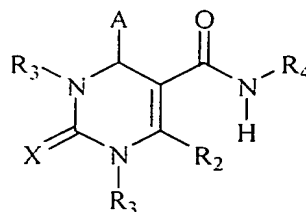
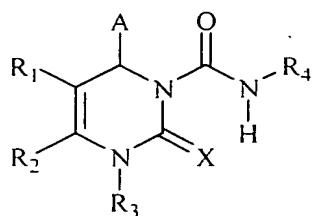
This invention further provides a pharmaceutical composition made by combining a therapeutically effective amount of the compound of this invention and a pharmaceutically acceptable carrier. This invention further provides a process for making a pharmaceutical composition comprising combining a therapeutically effective amount of the compound of the invention and a pharmaceutically acceptable carrier.

Detailed Description Of The Invention

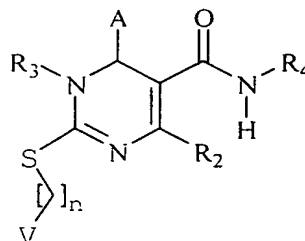
This invention provides a compound having the structure:

5

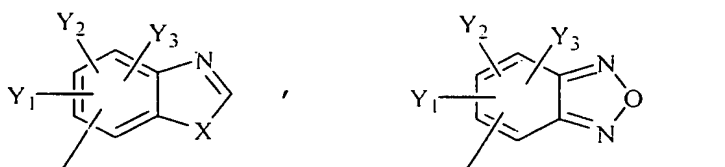
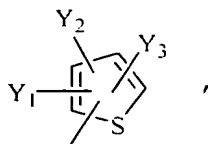
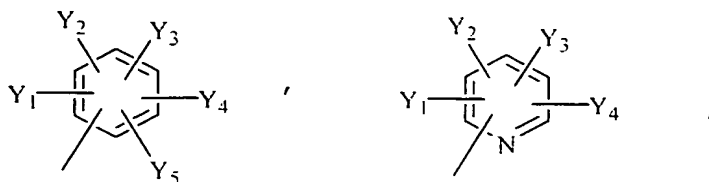
10



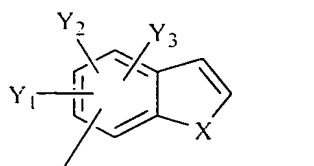
, or



wherein A is



or



25

wherein each of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 is independently -H;
 35 straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl
 or polyfluoroalkyl; straight chained or branched C_2 - C_7
 alkenyl or alkynyl; C_3 - C_7 cycloalkyl,
 monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; -F, -Cl, -Br, or -I; - NO_2 ; - N_3 ; -CN; - OR_3 ,
 40 - $OCOR_3$, - COR_3 , - $CON(R_3)_2$, or - $COOR_3$; or any two of Y_1 , Y_2 ,
 Y_3 , Y_4 and Y_5 present on adjacent carbon atoms can
 constitute a methylenedioxy group;

wherein each X is independently S; O; or NR_3 ;

45 wherein R_1 is -H; - NO_2 ; -CN; straight chained or branched

C₁-C- alkyl, monofluoroalkyl or polyfluoroalkyl; straight
chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇
cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
5 -CON(R₃)₂; or -CO₂(CH₂)_nV;

wherein R₂ is -H; straight chained or branched C₁-C₇
alkyl, hydroxyalkyl, alkoxyalkyl, monofluoroalkyl or
polyfluoroalkyl; straight chained or branched C₂-C₇
10 alkenyl or alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl; C₃-C₁₀ cycloalkyl-C₁-C₁₀-alkyl, C₃-C₁₀
cycloalkyl-C₁-C₁₀-monofluoroalkyl or C₃-C₁₀ cycloalkyl-C₁-
C₁₀-polyfluoroalkyl; -CN; -CH₂XR₃, -CH₂X(CH₂)_pNHR₃,
15 -(CH₂)_nNHR₃, -CH₂X(CH₂)_pN(R₃)₂, -CH₂X(CH₂)_pN₃,
-CH₂X(CH₂)_pNHCXR₇; -OR₃; or wherein R₁ and R₂ together form
a lactone ring;

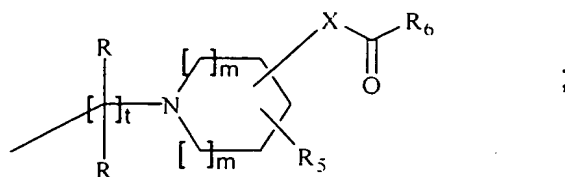
wherein each R₃ is independently -H; straight chained or
20 branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl;

25

wherein R_4 is

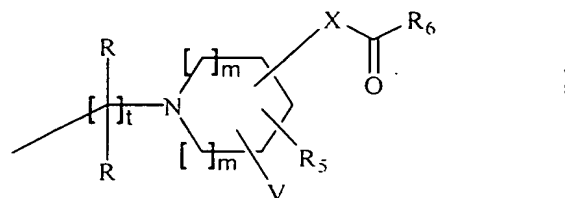
(i)

5



(ii)

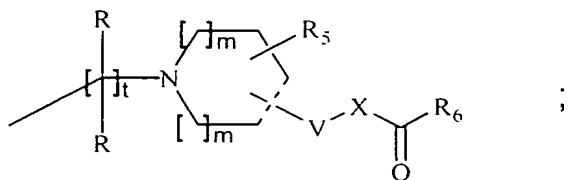
10



15

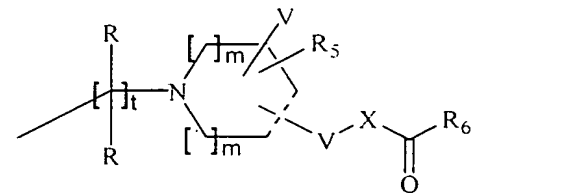
(iii)

20



25

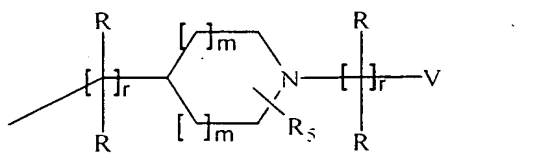
(iv)



30

(v)

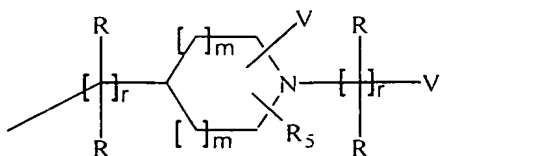
35



40

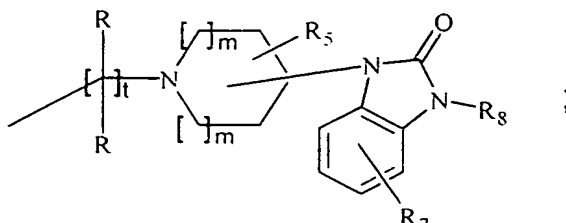
(vi)

45



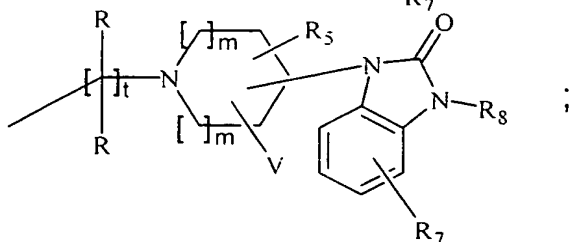
(vii)

5



(viii)

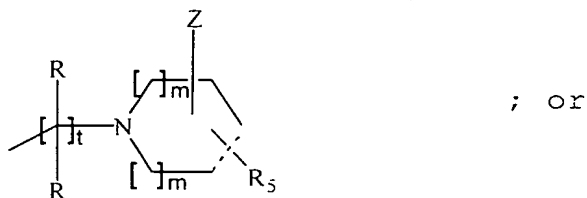
10



15

(ix)

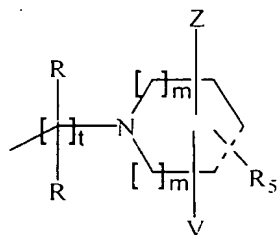
20



; or

(x)

25



30

wherein the dashed line represents a single bond or a double bond;

wherein each R is independently -H; -F; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; $-\text{N}(\text{R}_3)_2$; $-\text{NO}_2$; $-\text{CN}$; $-\text{CO}_2\text{R}_3$; $-\text{OR}_3$; or $-\text{CON}(\text{R}_3)_2$;

40

wherein each V is independently aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR_3 ; CO_2R_3 ; $-\text{CON}(\text{R}_3)_2$; CN ; $-\text{NO}_2$; $-\text{N}(\text{R}_3)_2$; $-\text{OR}_3$; $-\text{SR}_3$; $(\text{CH}_2)_q\text{OR}_3$; $(\text{CH}_2)_q\text{SR}_3$; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or

45

carboxamidoalkyl; straight chained or branched C₂-C₇-alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

5

wherein each R₅ is -H; -NO₂; -N₃; -CN; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; -CON(R₃)₂; aryl or heteroaryl, wherein the aryl or heteroaryl is optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

20

wherein R₆ is -H; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; -CON(R₃)₂; aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

30

35 wherein R₇ is H; F; Cl; Br; I; -NO₂; -N₃; -CN; straight

chained or branched C_1 - C_7 alkyl, monofluoroalkyl or
polyfluoroalkyl; straight chained or branched C_2 - C_7
alkenyl or alkynyl; C_3 - C_7 cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
5 cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or
 $-CON(R_3)_2$;

wherein R_8 is independently straight chained or branched
 C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight
10 chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7
cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein Z is naphthyl, quinolinyl, isoquinolinyl,
15 quinazolinyl, phthalazinyl, quinoxalinyl, indolyl,
benzo[b]furanyl, or benzo[b]thiophenyl; wherein the
naphthyl, quinolinyl, isoquinolinyl, quinazolinyl,
phthalazinyl, quinoxalinyl, indolyl, benzo[b]furanyl, or
benzo[b]thiophenyl may be substituted with one or more F;
20 Cl; Br; I; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN; $-NO_2$; $-N(R_3)_2$; $-OR_3$;
 $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained or branched
 C_1 - C_7 alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl,
or carboxamidoalkyl; straight chained or branched C_2 - C_7
alkenyl, C_2 - C_7 alkynyl; C_3 - C_7 cycloalkyl,
25 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein each m is independently an integer from 0 to 3
inclusive;

30 wherein each n is independently an integer from 0 to 5
inclusive;

wherein each p is independently an integer from 1 to 7
35 inclusive;

wherein q is an integer from 1 to 3 inclusive;

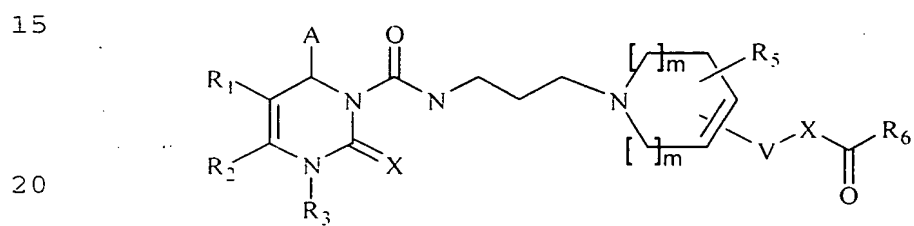
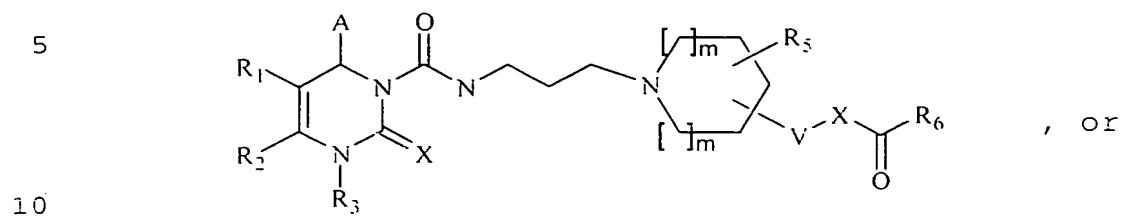
wherein r is an integer from 0 to 3 inclusive;

5 wherein t is an integer from 2 to 6 inclusive;

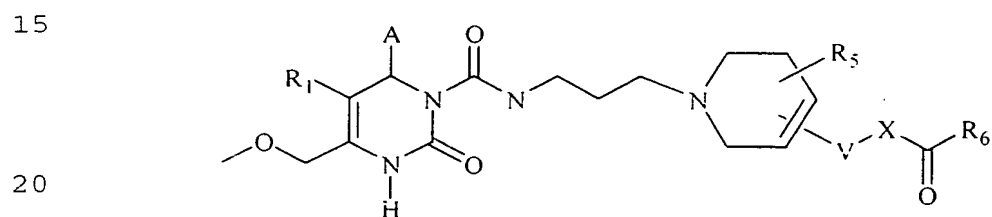
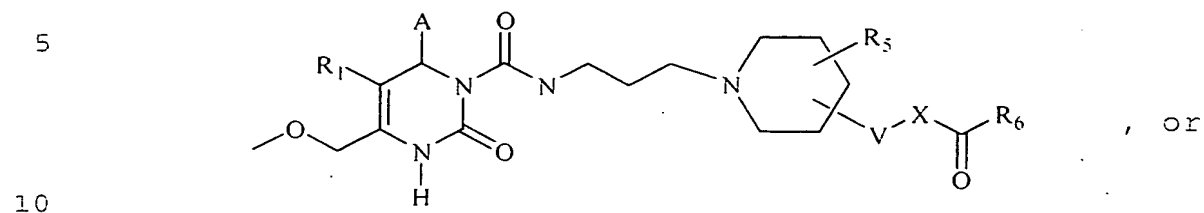
or a pharmaceutically acceptable salt thereof.

10 In one embodiment the compounds of this invention
comprise the (+) enantiomer. In another embodiment, the
compounds comprise the (-) enantiomer.

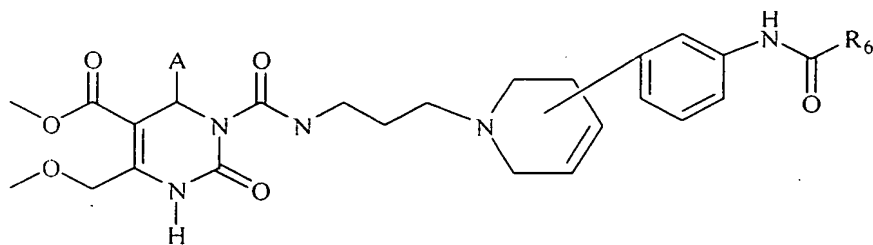
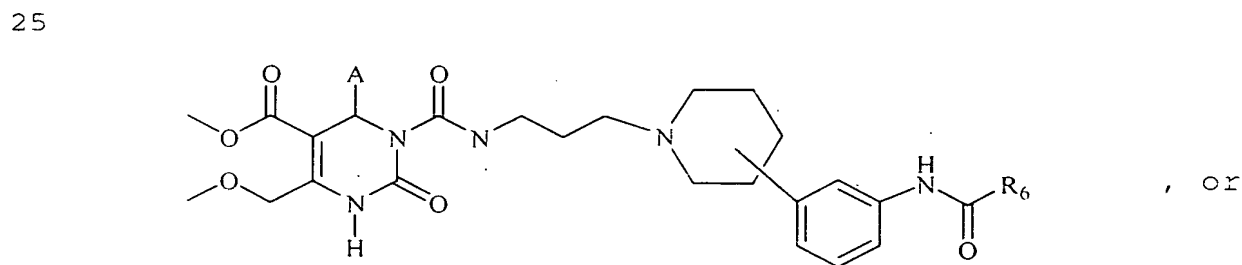
In one embodiment, the compound has the structure:



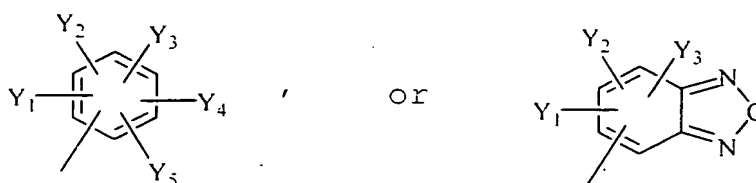
In another embodiment, the compound has the structure:



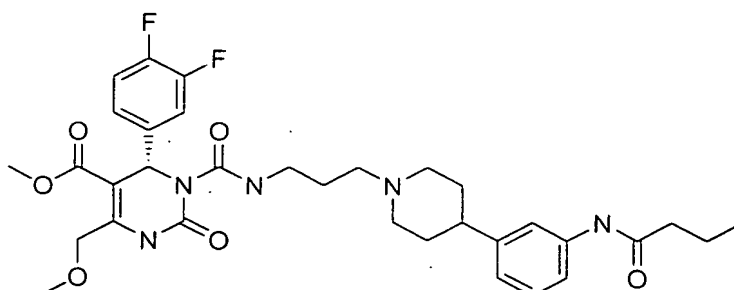
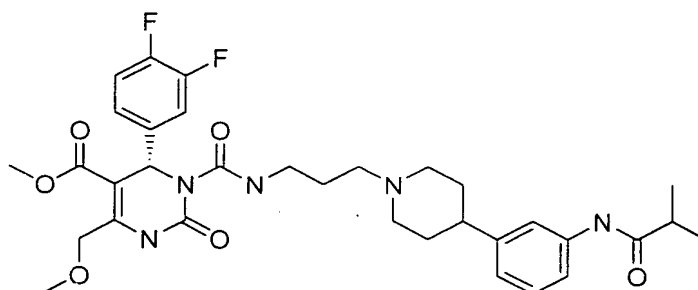
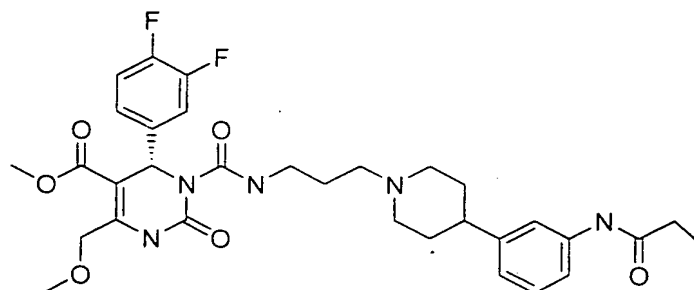
In a further embodiment, the compound has the structure:



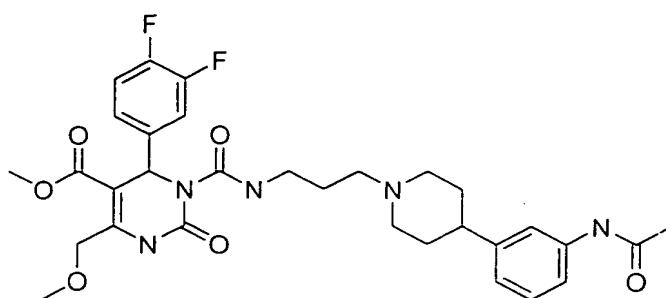
In yet another embodiment of the present invention variable A is



In an embodiment of the present invention, the compound is



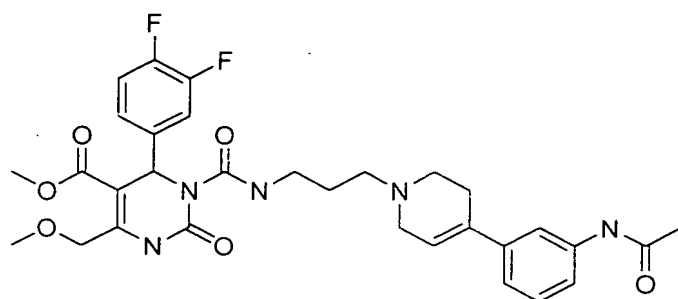
5



; or

10

15

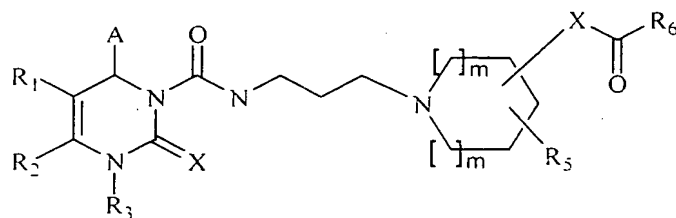


20

25

In another embodiment, the compound has the structure:

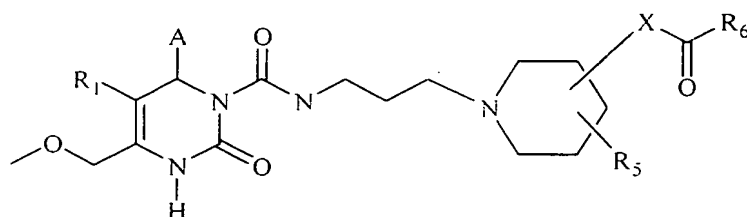
30



35

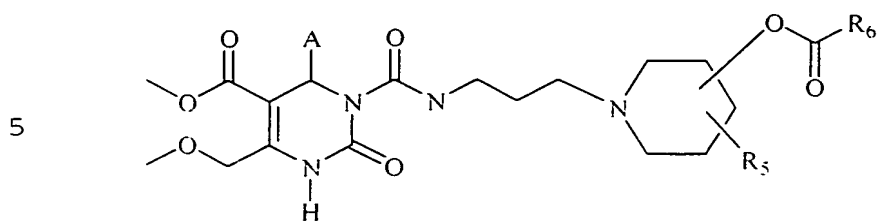
In further embodiments, the compound has the structure:

40



45

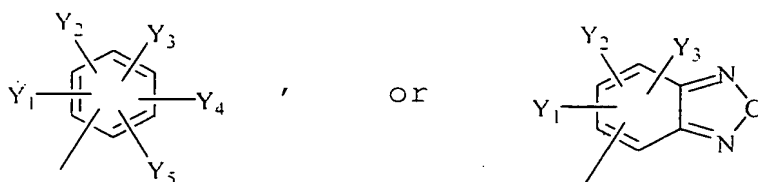
In an embodiment, the compound has the structure:



10

In other embodiments, A is

15

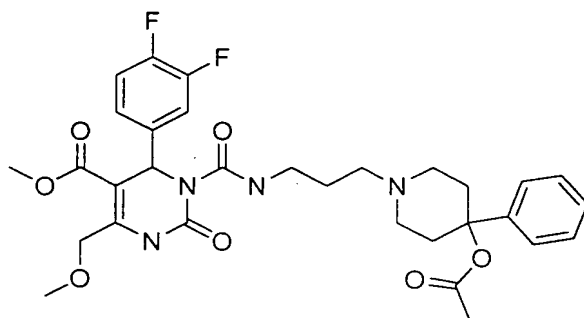


20

In an embodiment of the invention, the compound has the structure:

25

30

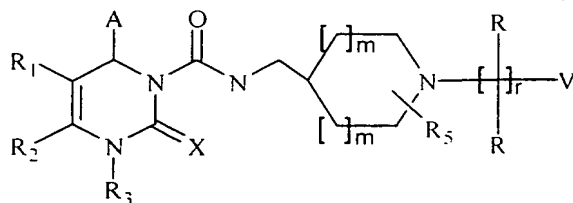


35

In other embodiments, the compound has the structure:

40

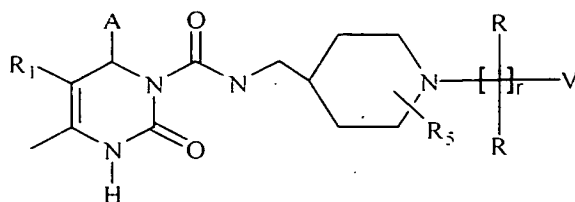
45



In additional embodiments, the compound has the structure:

5

10

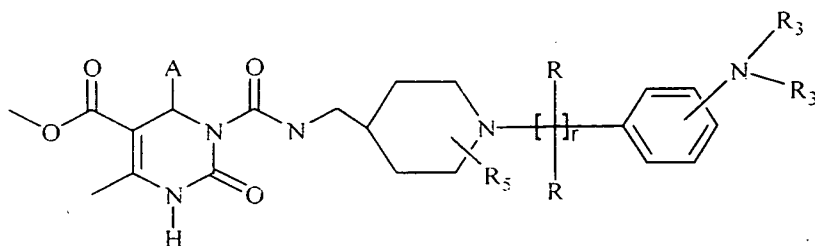


15

In one embodiment of the present invention, the compound has the structure:

20

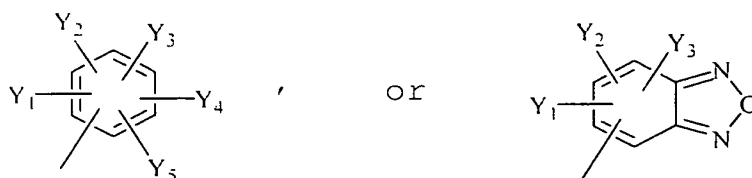
25



30

In another embodiment of the instant invention, A is

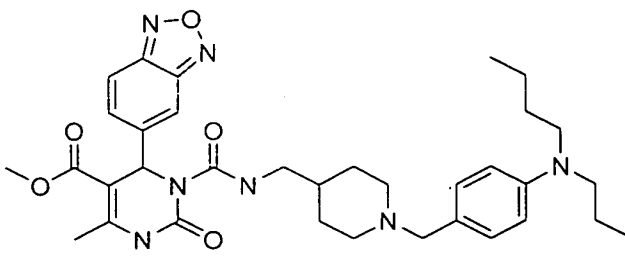
35



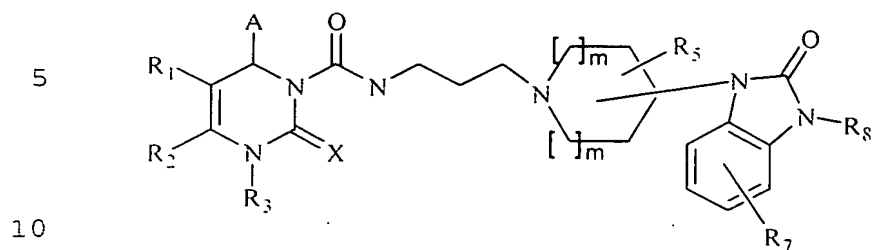
40

In other embodiments of the invention, the compound has the structure:

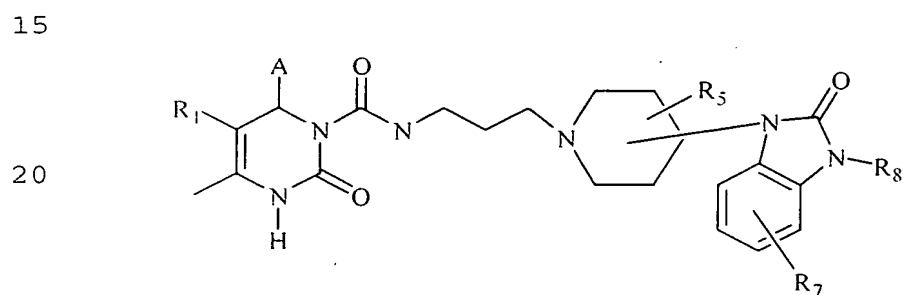
45



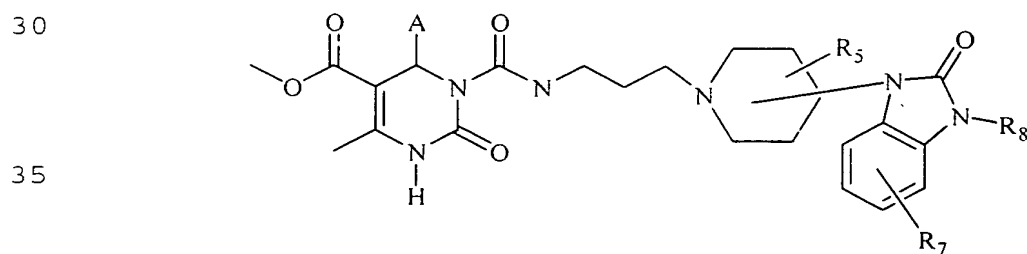
In an embodiment, the compound has the structure:



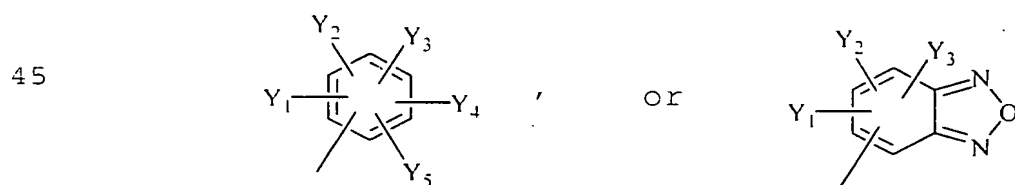
In another embodiment, the compound has the structure:



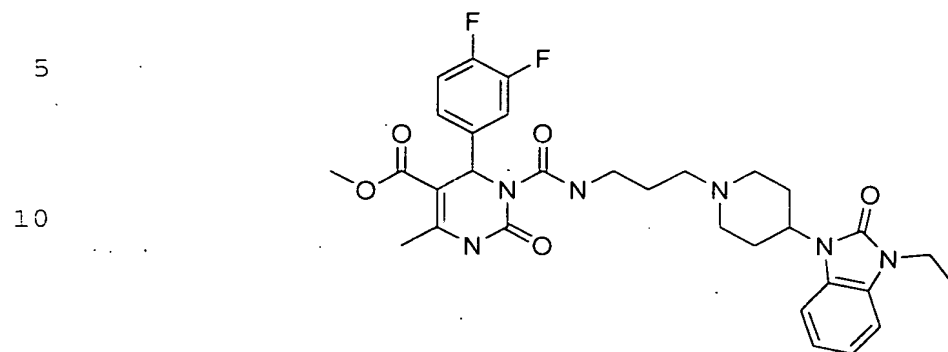
In yet another embodiment, the compound has the structure:



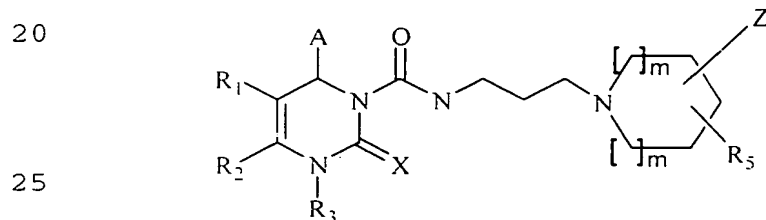
In an embodiment, A is



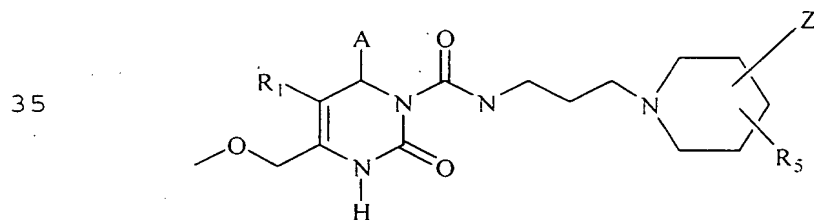
In a further embodiment, the compound has the structure



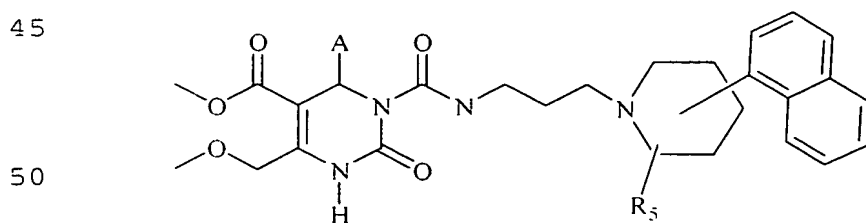
In another embodiment, the compound has the structure:



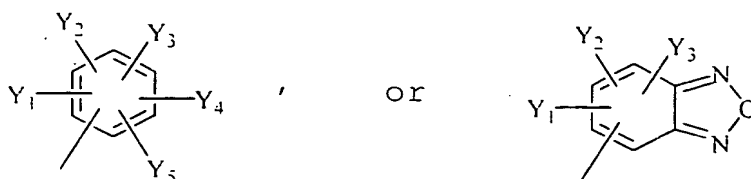
In yet another embodiment, the compound has the structure:



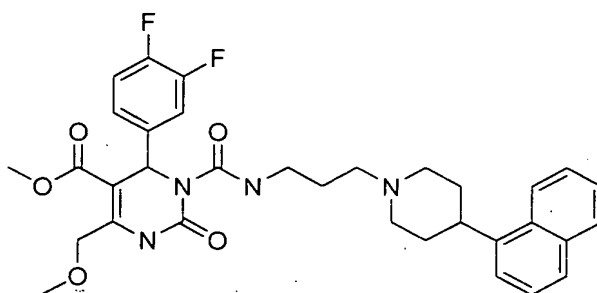
In an additional embodiment, the compound has the structure:



In other embodiments, A is

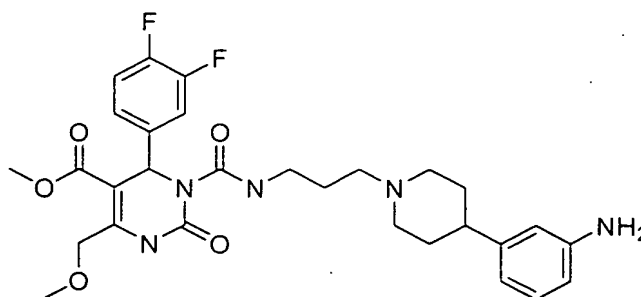


In an embodiment, the compound has the structure:

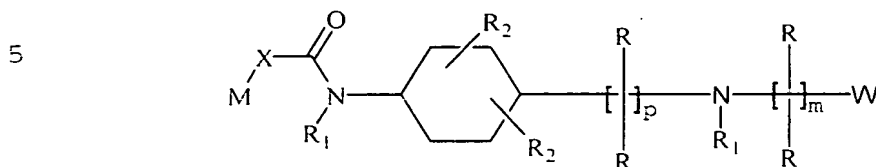


25 In yet another embodiment, the compound is
 (+)-1,2,3,6-tetra-hydro-1-{n-[4-(3,-acetamido)-phenyl-
 piperidin-1-yl]propyl}carboxamido-4-methoxymethyl-6-(3,4-
 difluoro-phenyl)-2-oxopyrimidine-5-carboxylic acid methyl
 ester. In a further embodiment, the compound is
 30 (-)-1,2,3,6-tetra-hydro-1-{n-[4-(3,-acet-amido)-phenyl-
 piperidin-1-yl]propyl}carboxamido-4-methoxymethyl-6-(3,4-
 difluoro-phenyl)-2-oxopyrimidine-5-carboxylic acid methyl
 ester.

35 In a further embodiment, the compound is:



In a further embodiment, the compound has the structure:



wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -SR₃; -CO₂R₃; or -OR₃;

wherein each R₁ is independently -H; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; or -CON(R₃)₂;

wherein each R₂ is -H; -NO₂; -N₃; -CN; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; or -CON(R₃)₂; or aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein each R₃ is independently -H; straight chained or

branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl;

5

wherein M is aryl or heteroaryl, optionally substituted
with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN;
-NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight
chained or branched C₁-C₇ alkyl, monofluoroalkyl,
10 polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl;
straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl;
C₃-C- cycloalkyl, monofluorocycloalkyl,
polyfluorocycloalkyl or cycloalkenyl;

10

15

wherein X is (CH₂)_n, O, S or NR₃;

wherein W is

20

(a) C₃-C₇ cycloalkyl, monofluorocycloalkyl,
polyfluorocycloalkyl or cycloalkenyl optionally
substituted with one or more COR₃; CO₂R₃; -CON(R₃)₂;
CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃;
straight chained or branched C₁-C₇ alkyl,
monofluoroalkyl, polyfluoroalkyl; aminoalkyl, or
25 carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl; or

25

30

(b) aryl or heteroaryl optionally substituted with one
or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN;
-NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃;
straight chained or branched C₁-C₇ alkyl,
monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl;

35

wherein m is an integer from 0 to 4 inclusive;

wherein n is an integer from 0 to 6 inclusive;

wherein p is an integer from 1 to 4 inclusive;

5 wherein q is an integer from 1 to 3 inclusive;

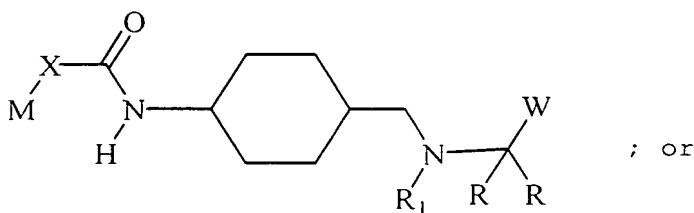
or a pharmaceutically acceptable salt thereof.

In one embodiment the compounds of this invention comprise
10 the (+) enantiomer. In another embodiment, the compounds
comprise the (-) enantiomer.

In an embodiment, the compound has the structure:

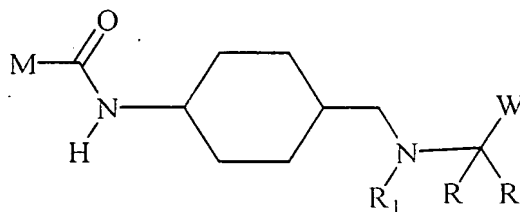
15

20



25

30

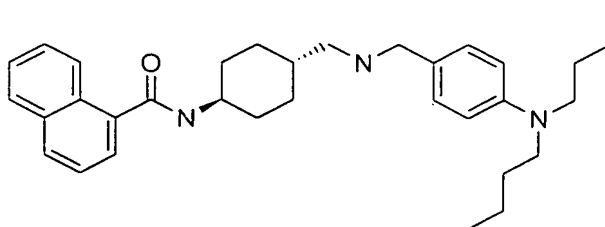


In a further embodiment, W is phenyl optionally
substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃;
35 -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; or
(CH₂)_qSR₃.

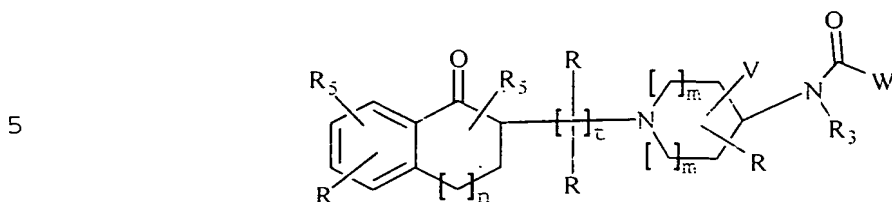
In another embodiment, the compound has the structure

40

45



In one embodiment, the compound has the structure:



10 wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or -CON(R₃)₂;

15 wherein each R₁ is independently -H; F; Cl; Br; I; -NO₂; -N₃; -CN; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
20 cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; -CON(R₃)₂; aryl or heteroaryl, wherein the aryl or heteroaryl is optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃;
25 -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
30 cycloalkenyl;

wherein each R₃ is independently -H; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
35 C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl

or cycloalkenyl;

wherein R_5 is -H; -NO₂; -N₃; -CN; straight chained or
branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
5 straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
-CON(R₃)₂; aryl or heteroaryl, wherein the aryl or
heteroaryl is optionally substituted with one or more F;
10 Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃;
-SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched
C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl,
or carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
15 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein V is H; aryl or heteroaryl, optionally
substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃;
20 -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃;
(CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl,
monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
25 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein W is

30 (a) C₃-C₇ cycloalkyl, monofluorocycloalkyl,
polyfluorocycloalkyl or cycloalkenyl optionally
substituted with one or more COR₃; CO₂R₃;
-CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃;
(CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or
35 branched C₁-C₇ alkyl, monofluoroalkyl,

polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched
C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl;
or

5

(b) aryl or heteroaryl optionally substituted with
one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂;
CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃;
(CH₂)_qSR₃; straight chained or branched C₁-C₇
10 alkyl, monofluoroalkyl, polyfluoroalkyl,
aminoalkyl, or carboxamidoalkyl; straight
chained or branched C₂-C₇ alkenyl, C₂-C₇
alkynyl; C₃-C₇ cycloalkyl;

15 wherein each m is independently an integer from 0 to 3
inclusive;

wherein n is an integer from 0 to 2 inclusive;

20 wherein p is an integer from 1 to 7 inclusive;

wherein q is an integer from 1 to 3 inclusive;

wherein t is an integer from 2 to 6 inclusive;

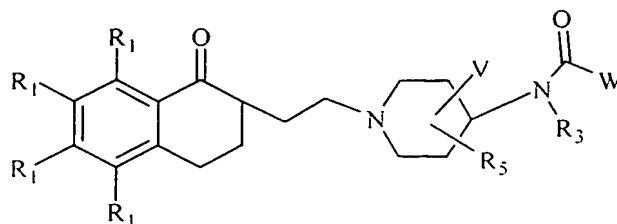
25

or a pharmaceutically acceptable salt thereof.

In one embodiment the compounds of this invention comprise
the (+) enantiomer. In another embodiment, the compounds
30 comprise the (-) enantiomer.

In an additional embodiment, the compound has the
structure:

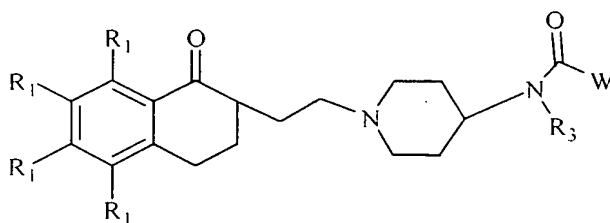
5



10

In a further embodiment, the compound has the structure

15



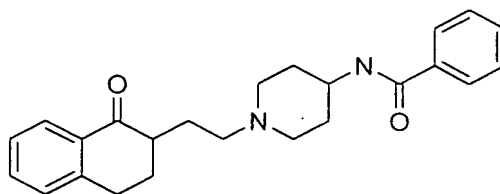
20

In yet another embodiment, W is phenyl optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; or straight chained or branched C₁-C₇ alkyl groups.

25

In yet another embodiment, the compound has the structure

30



35

In the present invention, the term "aryl" includes phenyl and naphthyl and the term "heteroaryl" is used to include five and six membered unsaturated rings that may contain one or more heteroatoms such as oxygen, sulfur, and nitrogen. Examples of heteroaryl groups include, but are not limited to, furanyl, thienyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, pyrazolyl, isoxazolyl, isothiazolyl, oxadiazolyl, triazolyl, thiadiazolyl, pyridyl, pyridazinyl, pyrimidinyl, pyrazinyl, and triazinyl.

In addition the term "heteroaryl" is used to include fused bicyclic ring systems that may contain one or more heteroatoms such as oxygen, sulfur and nitrogen. Examples of such heteroaryl groups include, but are not limited to, indolizinyll, indolyl, isoindolyl, benzo[b]furanyl, benzo[b]thiophenyl, indazolyl, benzimidazolyl, benzthiazolyl, purinyl, imidazo[2,1-b]thiazolyl, quinolinyl, isoquinolinyl, quinolizinyll, and 2,1,3-benzothiazolyl.

Included in this invention are pharmaceutically acceptable salts and complexes of all of the compounds described herein. The salts include but are not limited to the acids and bases listed herein. The salts include, but are not limited to the following inorganic acids: hydrochloric acid, hydrobromic acid, hydroiodic acid, sulfuric acid and boric acid. The salts include, but are not limited to the following organic acids: acetic acid, malonic acid, succinic acid, fumaric acid, tartaric acid, maleic acid, citric acid, methanesulfonic acid, benzoic acid, glycolic acid, lactic acid and mandelic acid. The salts include, but are not limited to the inorganic base, ammonia. The salts include, but are not limited to the following organic bases: methylamine, ethylamine, propylamine, dimethylamine, diethylamine, trimethylamine, triethylamine,

ethylenediamine, hydroxyethylamine, morpholine, piperazine and guanidine. This invention further provides for the hydrates and polymorphs of all of the compounds described herein.

5

The present invention includes within its scope prodrugs of the compounds of the invention. In general, such prodrugs will be functional derivatives of the compounds of the invention which are readily convertible in vivo into the
10 required compound. Thus, in the present invention, the term "administering" shall encompass the treatment of the various conditions described with the compound specifically disclosed or with a compound which may not be specifically disclosed, but which converts to the specified compound in
15 vivo after administration to the patient. Conventional procedures for the selection and preparation of suitable prodrug derivatives are described, for example, in Design of Prodrugs, ed. H. Bundgaard, Elsevier, 1985.

20 The present invention further includes metabolites of the compounds of the present invention. Metabolites include active species produced upon introduction of compounds of this invention into the biological milieu.

25 This invention further provides a pharmaceutical composition comprising a therapeutically effective amount of the compound of the invention and a pharmaceutically acceptable carrier. In one embodiment, the amount of the compound is an amount from about 0.01 mg to about 800 mg.
30 In another embodiment, the amount of the compound is an amount from about 0.01 mg to about 500 mg. In another embodiment, the amount of the compound is an amount from about 0.01 mg to about 250 mg. In another embodiment, the amount of the compound is an amount from about 0.1 mg to
35 about 60 mg. In another embodiment, the amount of the

compound is an amount from about 1 mg to about 20 mg. In
a further embodiment, the carrier is a liquid and the
composition is a solution. In another embodiment, the
carrier is a solid and the composition is a tablet. In a
5 further embodiment, the carrier is a gel and the
composition is a suppository.

This invention provides a pharmaceutical composition made
by combining a therapeutically effective amount of the
10 compound of this invention and a pharmaceutically
acceptable carrier.

This invention provides a process for making a
pharmaceutical composition comprising combining a
15 therapeutically effective amount of the compound of this
invention and a pharmaceutically acceptable carrier.

In the practice of this invention the "pharmaceutically
acceptable carrier" is any physiological carrier known to
20 those of ordinary skill in the art useful in formulating
pharmaceutical compositions.

In one preferred embodiment the pharmaceutical carrier may
be a liquid and the pharmaceutical composition would be in
25 the form of a solution. In another equally preferred
embodiment, the pharmaceutically acceptable carrier is a
solid and the composition is in the form of a powder or
tablet. In a further embodiment, the pharmaceutical carrier
is a gel and the composition is in the form of a
30 suppository or cream. In a further embodiment the compound
may be formulated as a part of a pharmaceutically
acceptable transdermal patch.

A solid carrier can include one or more substances which
35 may also act as flavoring agents, lubricants, solubilizers,

suspending agents, fillers, glidants, compression aids, binders or tablet-disintegrating agents; it can also be an encapsulating material. In powders, the carrier is a finely divided solid which is in admixture with the finely divided active ingredient. In tablets, the active ingredient is mixed with a carrier having the necessary compression properties in suitable proportions and compacted in the shape and size desired. The powders and tablets preferably contain up to 99% of the active ingredient. Suitable solid carriers include, for example, calcium phosphate, magnesium stearate, talc, sugars, lactose, dextrin, starch, gelatin, cellulose, polyvinylpyrrolidone, low melting waxes and ion exchange resins.

Liquid carriers are used in preparing solutions, suspensions, emulsions, syrups, elixirs and pressurized compositions. The active ingredient can be dissolved or suspended in a pharmaceutically acceptable liquid carrier such as water, an organic solvent, a mixture of both or pharmaceutically acceptable oils or fats. The liquid carrier can contain other suitable pharmaceutical additives such as solubilizers, emulsifiers, buffers, preservatives, sweeteners, flavoring agents, suspending agents, thickening agents, colors, viscosity regulators, stabilizers or osmo-regulators. Suitable examples of liquid carriers for oral and parenteral administration include water (partially containing additives as above, e.g. cellulose derivatives, preferably sodium carboxymethyl cellulose solution), alcohols (including monohydric alcohols and polyhydric alcohols, e.g. glycols) and their derivatives, and oils (e.g. fractionated coconut oil and arachis oil). For parenteral administration, the carrier can also be an oily ester such as ethyl oleate and isopropyl myristate. Sterile liquid carriers are useful in sterile liquid form

compositions for parenteral administration. The liquid carrier for pressurized compositions can be halogenated hydrocarbon or other pharmaceutically acceptable propellant.

5

Liquid pharmaceutical compositions which are sterile solutions or suspensions can be utilized by for example, intramuscular, intrathecal, epidural, intraperitoneal or subcutaneous injection. Sterile solutions can also be administered intravenously. The compounds may be prepared as a sterile solid composition which may be dissolved or suspended at the time of administration using sterile water, saline, or other appropriate sterile injectable medium. Carriers are intended to include necessary and inert binders, suspending agents, lubricants, flavorants, sweeteners, preservatives, dyes, and coatings.

10

The compound can be administered orally in the form of a sterile solution or suspension containing other solutes or suspending agents (for example, enough saline or glucose to make the solution isotonic), bile salts, acacia, gelatin, sorbitan monoleate, polysorbate 80 (oleate esters of sorbitol and its anhydrides copolymerized with ethylene oxide) and the like.

20

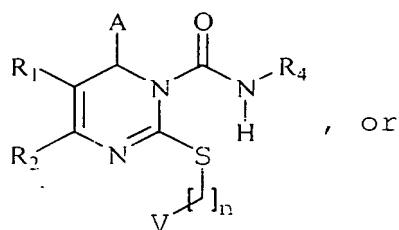
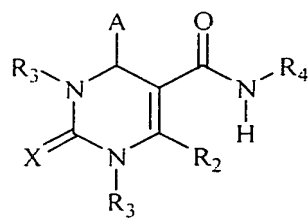
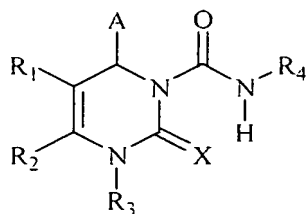
The compound can also be administered orally either in liquid or solid composition form. Compositions suitable for oral administration include solid forms, such as pills, capsules, granules, tablets, and powders, and liquid forms, such as solutions, syrups, elixirs, and suspensions. Forms useful for parenteral administration include sterile solutions, emulsions, and suspensions.

25

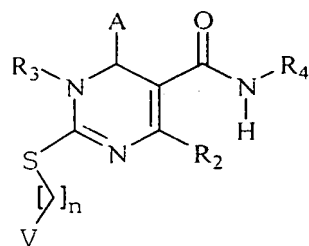
30

The present invention also provides a method of modifying feeding behavior of a subject which comprises administering to the subject an amount of a compound effective to decrease the consumption of food by the subject wherein the compound has the structure:

10

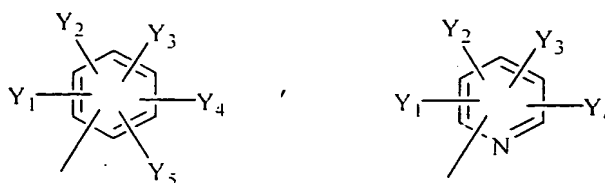


, or

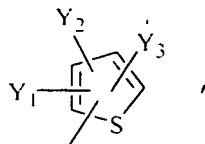


wherein A is

5



10

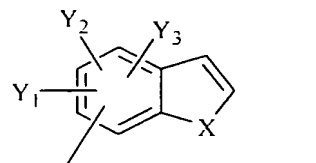


15



20

or



wherein each of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -F, -Cl, -Br, or -I; - NO_2 ; - N_3 ; -CN; - OR_3 , - $OCOR_3$, - COR_3 , - $CON(R_3)_2$, or - $COOR_3$; or any two of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 present on adjacent carbon atoms can constitute a methylenedioxy group;

wherein each X is independently S; O; or NR_3 ;

wherein R_1 is -H; - NO_2 ; -CN; straight chained or branched

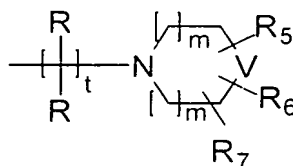
C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight
 chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7
 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$;
 5 $-CON(R_3)_2$; or $CO_2(CH_2)_nV$;

wherein R_2 is $-H$; straight chained or branched C_1 - C_7
 alkyl, hydroxyalkyl, alkoxyalkyl, aminoalkyl,
 monofluoroalkyl or polyfluoroalkyl; straight chained or
 10 branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl,
 monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; C_3 - C_{10} cycloalkyl- C_1 - C_{10} -alkyl, C_3 - C_{10}
 cycloalkyl- C_1 - C_{10} -monofluoroalkyl or C_3 - C_{10} cycloalkyl- C_1 -
 C_{10} -polyfluoroalkyl; $-CN$; $-CH_2XR_3$, $-CH_2X(CH_2)_pNHR_3$,
 15 $-(CH_2)_nNHR_3$, $-CH_2X(CH_2)_pN(R_3)_2$, $-CH_2X(CH_2)_pN_3$,
 $-CH_2X(CH_2)_pNHCXR_5$; $-OR_3$; or R_1 and R_2 together form a
 lactone ring;

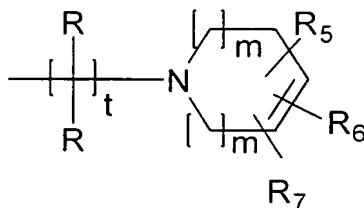
wherein each R_3 is independently $-H$; straight chained or
 20 branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl;
 straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 -
 C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
 or cycloalkenyl;

25 wherein R_4 is

(i)



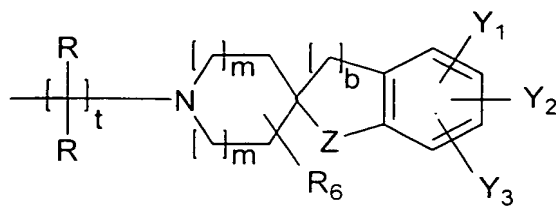
(ii)



35

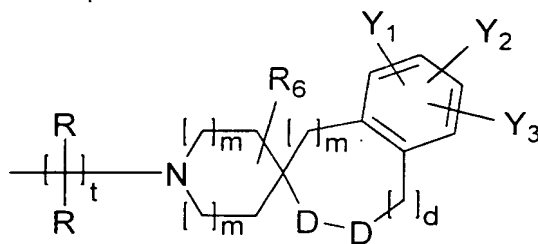
(iii)

5



(iv)

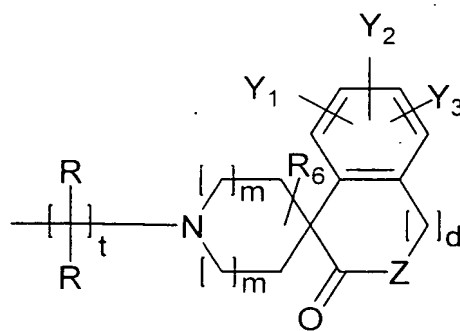
10



15

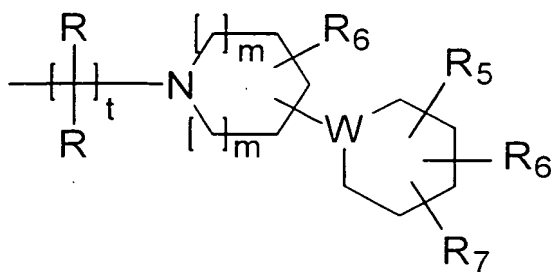
(v)

20

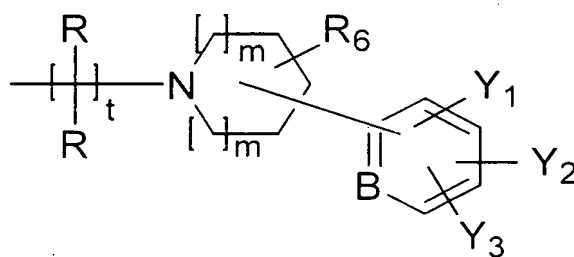


25

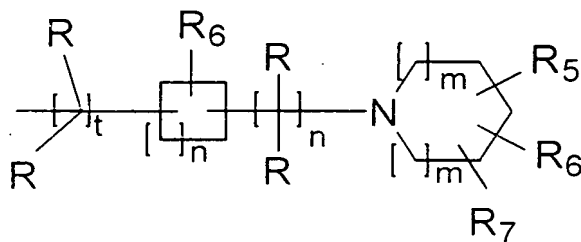
(vi)



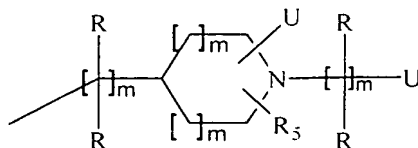
(vii)



(viii)

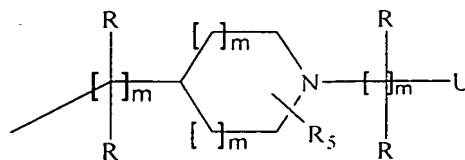


(ix)



; or

(x)



wherein each R is independently -H; -F; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C₂-C-alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or
5 -CN(R₃)₂;

wherein B is N or CY₄;

wherein each D is independently C(R₃)₂; O; S; NR₃; CO; or
10 CS;

wherein each U is independently aryl or heteroaryl, optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃;
15 (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or carboxamidoalkyl; straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
20 cycloalkenyl;

wherein V is C(R₅)₂; CR₅R₆; NR₅ or NR₆;

wherein W is CR₅; CR₆ or N;
25

wherein Z is S; O; C(R₃)₂; or NR₃;

wherein each R₅ is -H; -NO₂; -N₃; -CN; straight chained or branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
30 straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; or -CON(R₃)₂; -XCOR₈; or aryl or heteroaryl, wherein the aryl or heteroaryl is optionally substituted with one or
35 more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂;

5 $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; $-XCOR_8$; straight
 chained or branched C_1-C_7 alkyl, monofluoroalkyl,
 polyfluoroalkyl, or aminoalkyl; straight chained or
 branched C_2-C_7 alkenyl, C_2-C alkynyl; C_3-C_7 cycloalkyl,
 monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl;

10 wherein each R_6 is independently $-H$; straight chained or
 branched C_1-C_7 alkyl, hydroxyalkyl, aminoalkyl,
 alkoxyalkyl, monofluoroalkyl or polyfluoroalkyl; straight
 chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7
 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$;
 or $-CON(R_3)_2$;

15 wherein R_7 is $-H$; aryl or heteroaryl, optionally
 substituted with one or more F ; Cl ; Br ; I ; COR_3 ; CO_2R_3 ;
 $-CON(R_3)_2$; CN ; $-NO_2$; $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$;
 $(CH_2)_qSR_3$; $-XCOR_8$; straight chained or branched C_1-C_7
 20 alkyl, monofluoroalkyl, polyfluoroalkyl, or aminoalkyl;
 straight chained or branched C_2-C_7 alkenyl, C_2-C_7 alkynyl;
 C_3-C cycloalkyl, monofluorocycloalkyl,
 polyfluorocycloalkyl or cycloalkenyl;

25 wherein R_8 is $-H$; straight chained or branched C_1-C_7
 alkyl, monofluoroalkyl or polyfluoroalkyl; straight
 chained or branched C_2-C_7 alkenyl or alkynyl; C_3-C_7
 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
 cycloalkenyl; $-N(R_3)_2$; $-OR_3$; $-(CH_2)_pOR_3$; $-COR_3$; $-CO_2R_3$; or
 30 $-CON(R_3)_2$; aryl or heteroaryl, optionally substituted with
 one or more F ; Cl ; Br ; I ; COR_3 ; CO_2R_3 ; $-CON(R_3)_2$; CN ; $-NO_2$;
 $-N(R_3)_2$; $-OR_3$; $-SR_3$; $(CH_2)_qOR_3$; $(CH_2)_qSR_3$; straight chained
 or branched C_1-C_7 alkyl, monofluoroalkyl, polyfluoroalkyl,
 aminoalkyl, or carboxamidoalkyl; straight chained or
 35 branched C_2-C_7 alkenyl, C_2-C_7 alkynyl; C_3-C_7 cycloalkyl,

monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein b is 1 or 2;

wherein d is an integer from 0 to 2 inclusive;

wherein each m is independently an integer from 0 to 3 inclusive;

wherein each n is independently an integer from 0 to 5 inclusive;

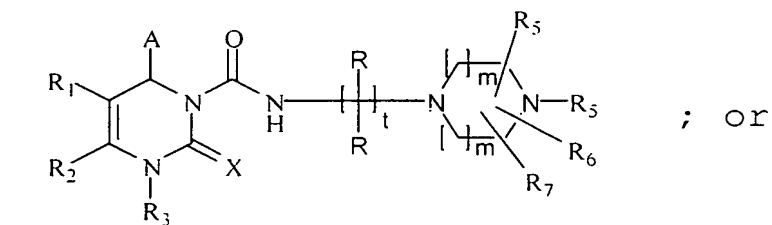
wherein each p is independently an integer from 1 to 7 inclusive;

wherein q is an integer from 1 to 3 inclusive;

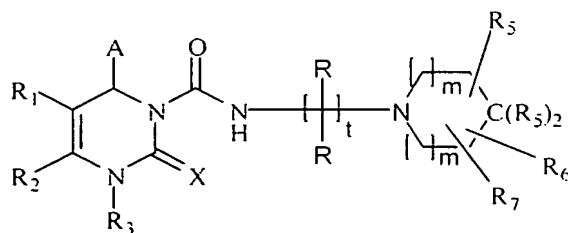
wherein t is an integer from 2 to 6 inclusive;

or a pharmaceutically acceptable salt thereof.

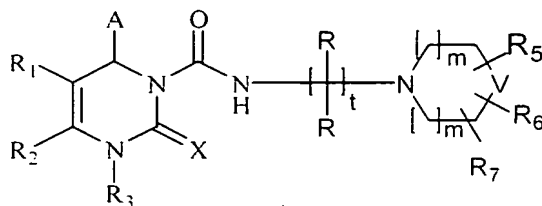
In one embodiment, the compound has the structure



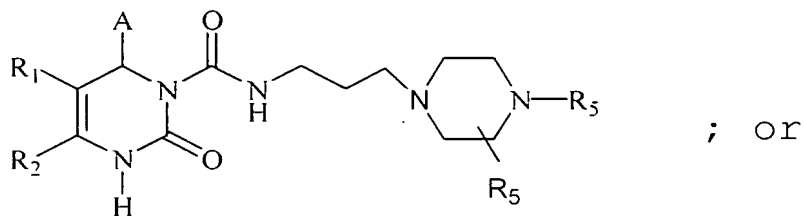
; or



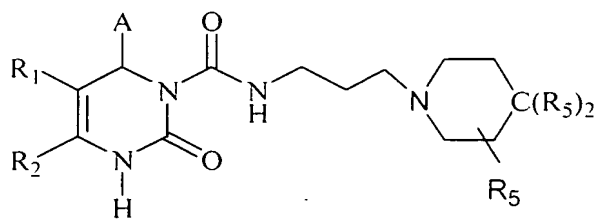
In a further embodiment, the compound has the structure



In an additional embodiment, the compound has the structure

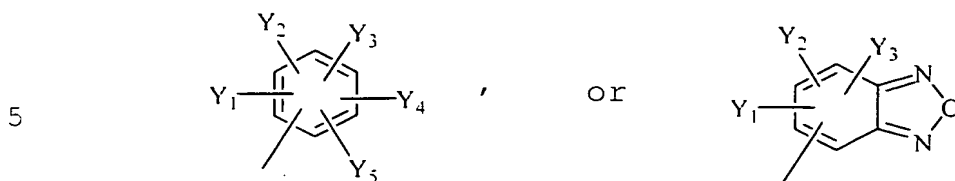


; or

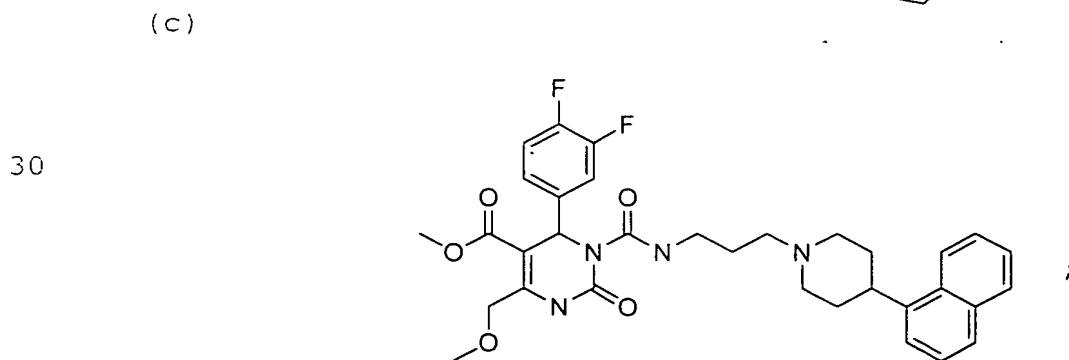
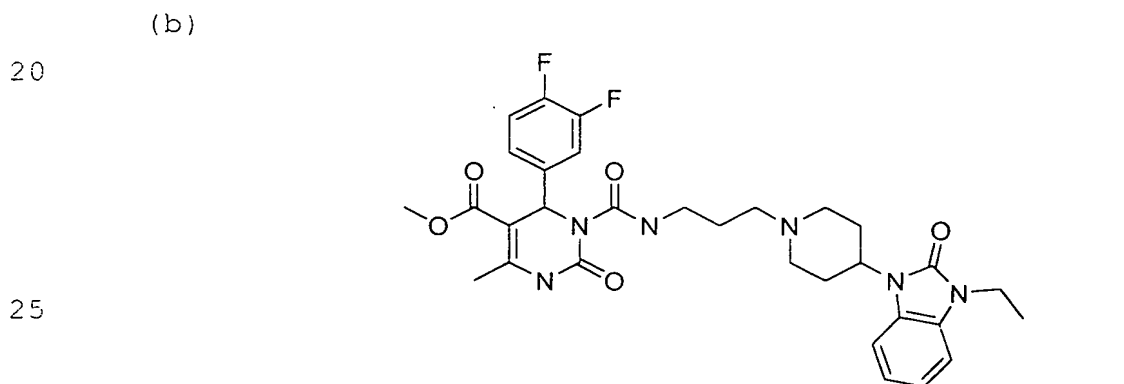
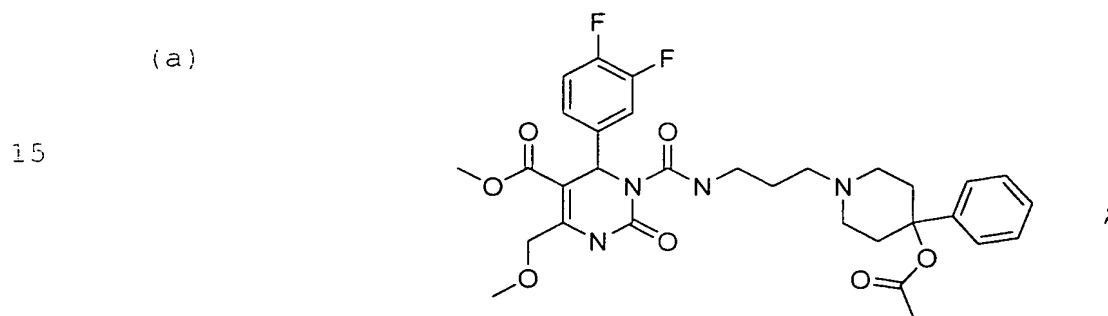


In a further embodiment, at least one R₅ group is an aryl or heteroaryl group optionally substituted with one or more F; Cl; Br; I; -NO₂; -N(R₃)₂; -OR₃; -XCOR₈; or straight chained or branched C₁-C₇ alkyl.

In another embodiment, A is:



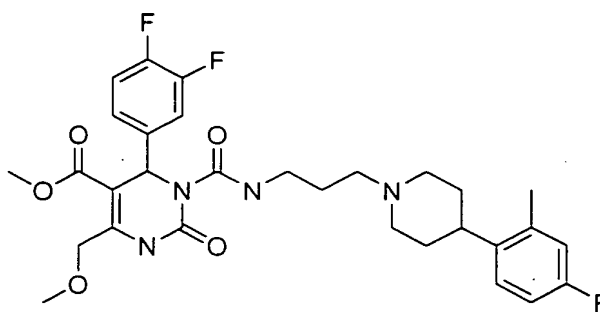
10 In further embodiments, the compound is selected from the group consisting of:



35

(d)

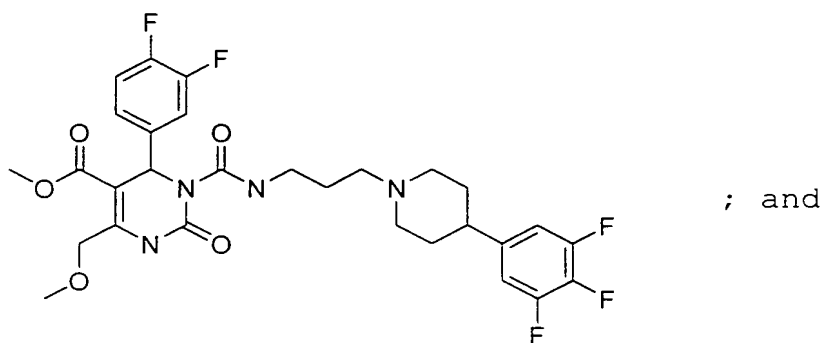
5



(e)

10

15

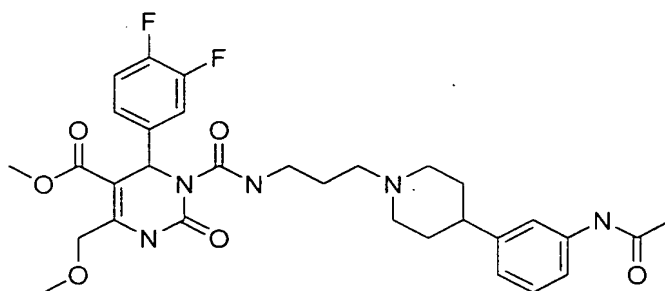


; and

(f)

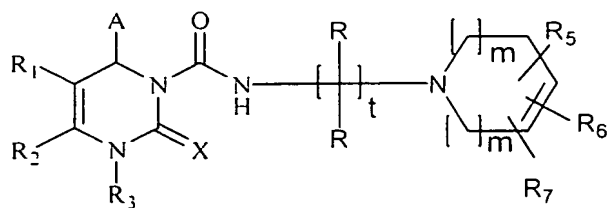
20

25

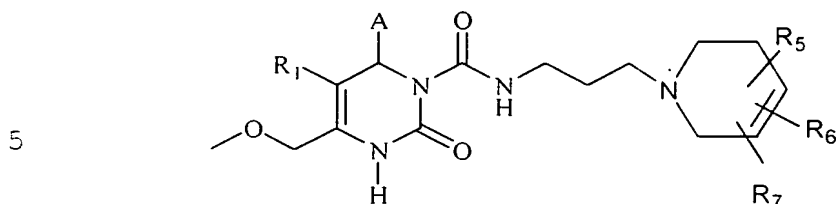


In other embodiments, the compound has the structure

30

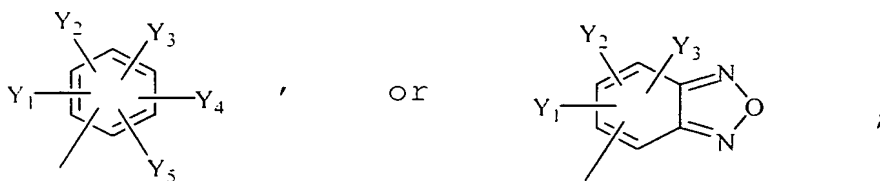


In a further embodiment, the compound has the structure



In additional embodiments, A is

10



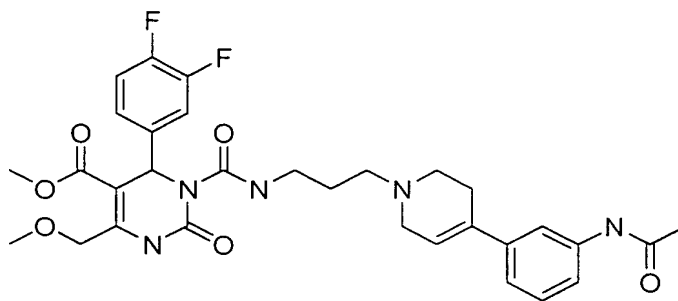
15

and R₇ is phenyl, optionally substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; -XCOR₃; or straight chained or branched C₁-C₇ alkyl.

20

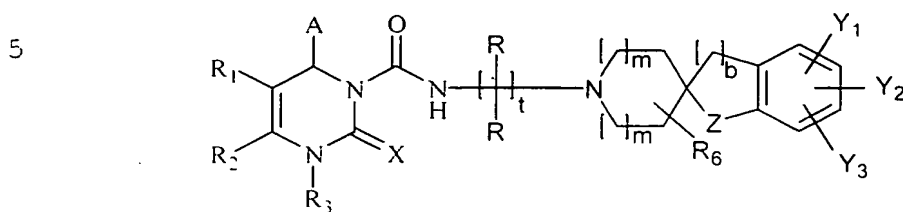
In one embodiment, the compound has the structure

25



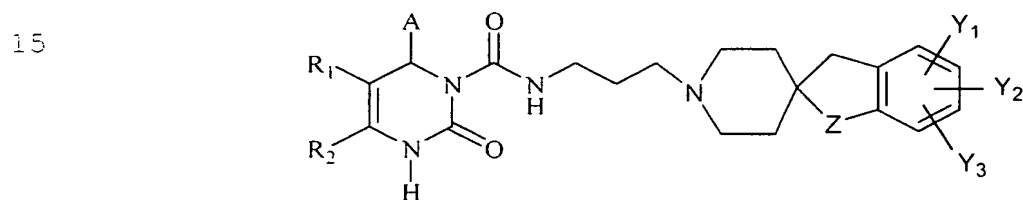
30

In an embodiment of the present invention, the compound has the structure



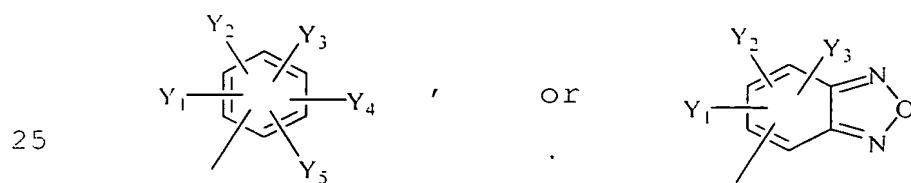
10

In yet another embodiment, the compound has the structure



20

In further embodiments, A is



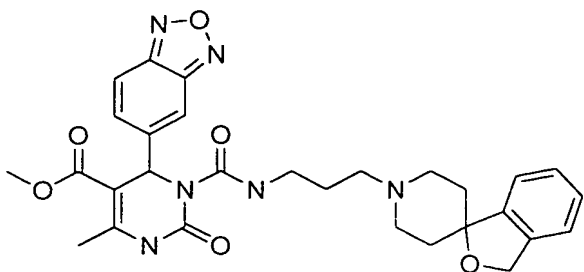
and Z is O or CH₂.

30

In an additional embodiment, the compound is selected from the group consisting of

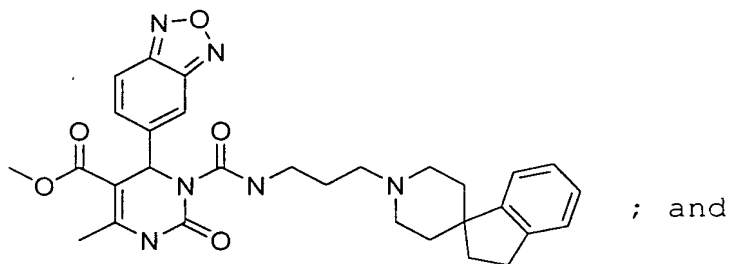
5

10



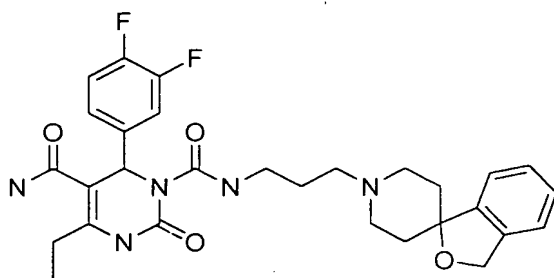
15

20

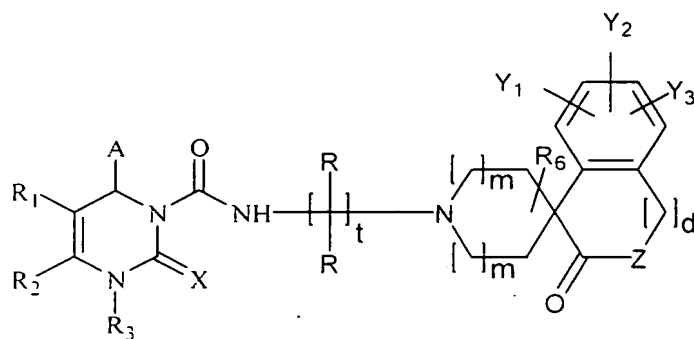


25

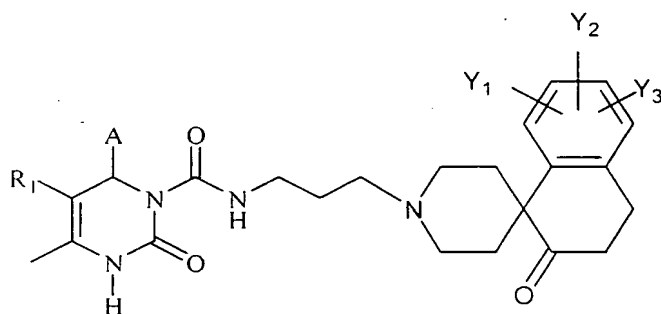
30



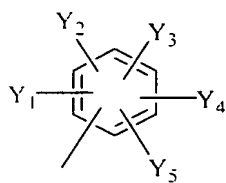
In one embodiment, the compound has the structure



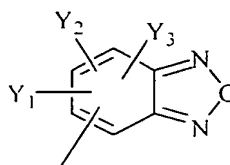
In a further embodiment, the compound has the structure



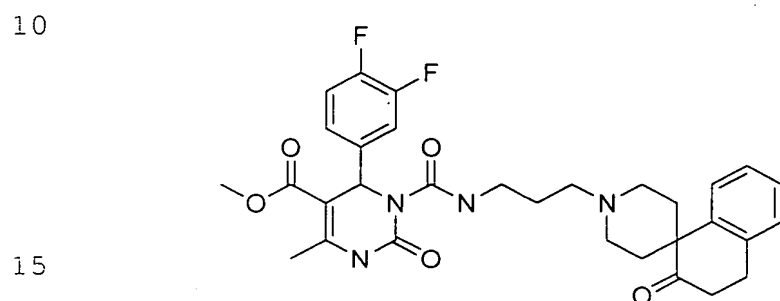
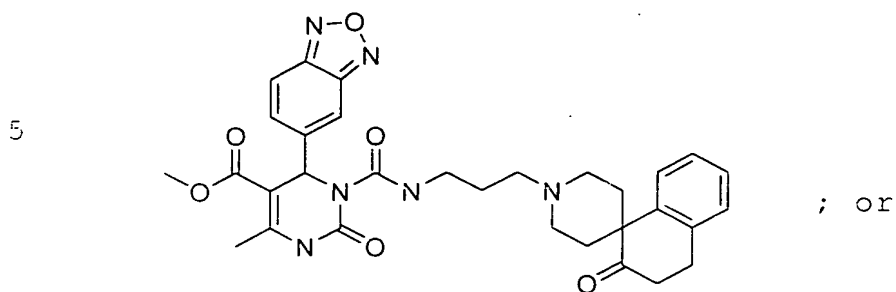
In another embodiment, A is



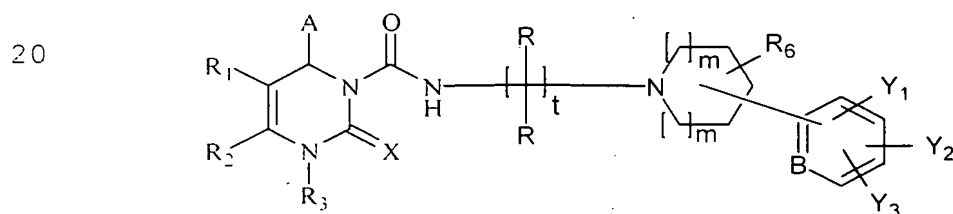
or



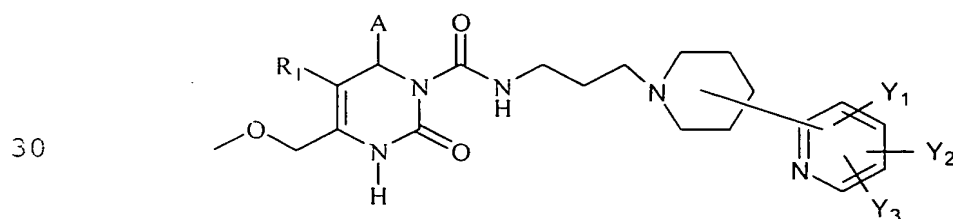
In yet another embodiment, the compound is



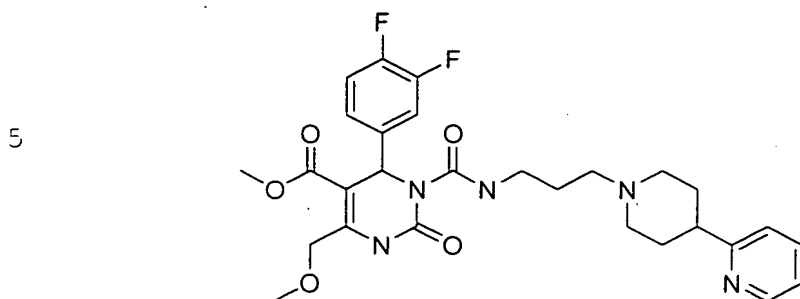
In a further embodiment, the compound has the structure



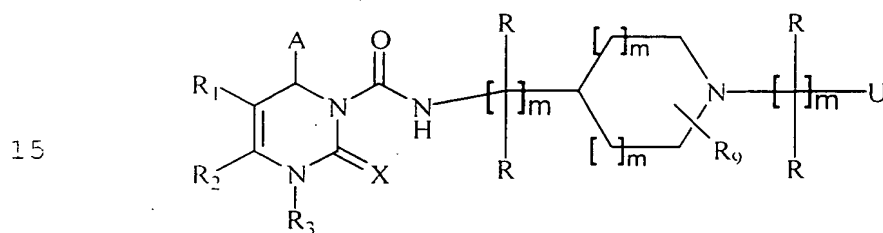
25 In another embodiment, the compound has the structure



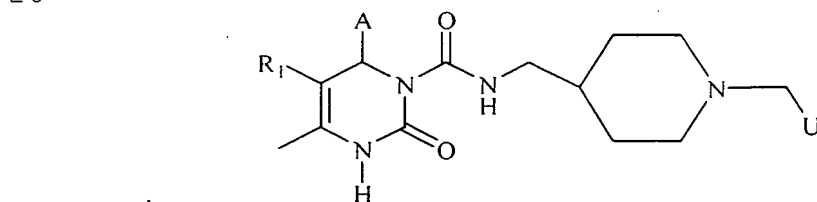
In yet another embodiment, the compound has the structure



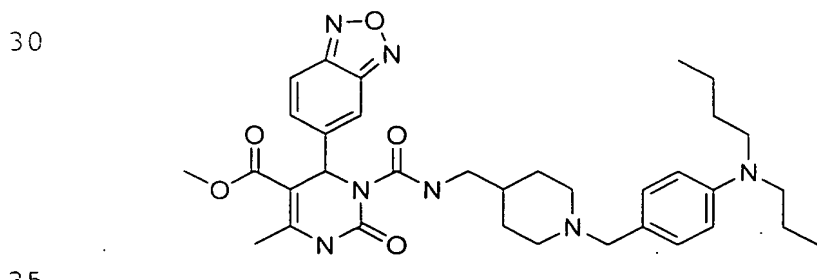
10 In one embodiment, the compound has the structure



20 In another embodiment, the compound has the structure

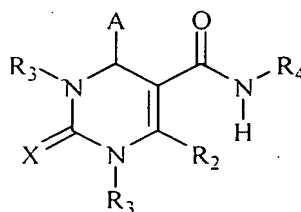
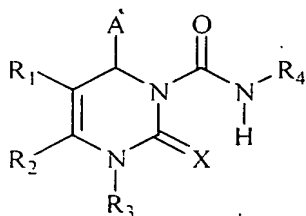


In another embodiment, the compound has the structure

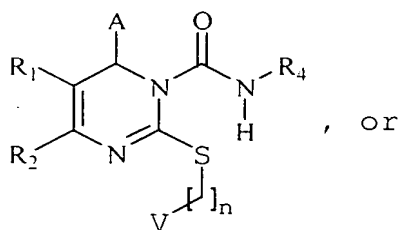


This invention further provides a method of reducing the
body mass of a subject which comprises administering to the
subject an amount of a compound effective to reduce the
body mass of the subject wherein the compound has the
5 structure:

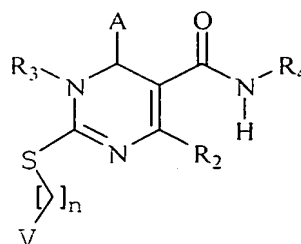
10



15

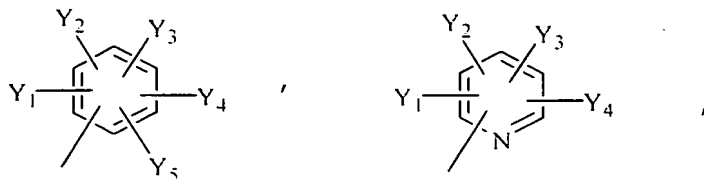


, or

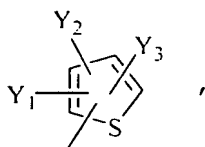


wherein A is

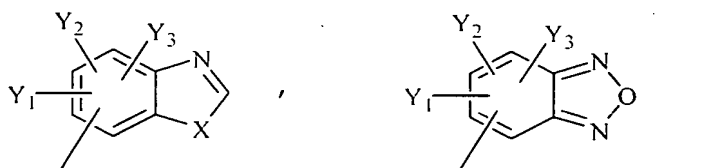
5



10

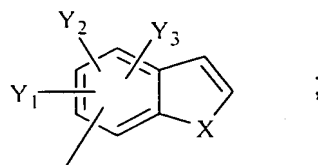


15



20

or



25

wherein each of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; -F, -Cl, -Br, or -I; - NO_2 ; - N_3 ; -CN; - OR_3 , - $OCOR_3$, - COR_3 , - $CON(R_3)_2$, or - $COOR_3$; or any two of Y_1 , Y_2 , Y_3 , Y_4 and Y_5 present on adjacent carbon atoms can constitute a methylenedioxy group;

30

wherein each X is independently S; O; or NR_3 ;

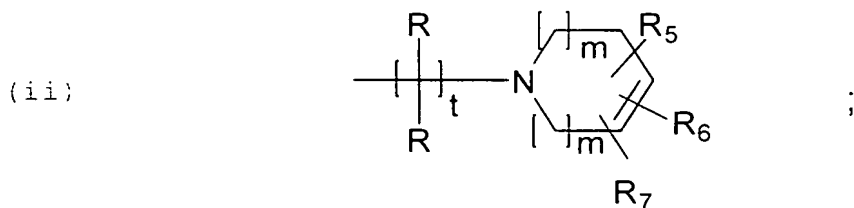
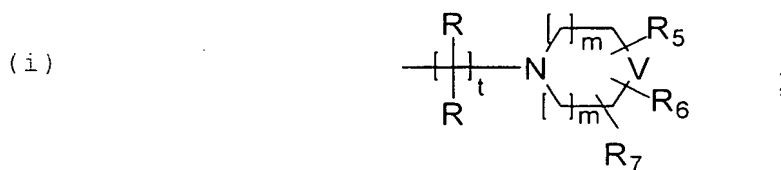
35

wherein R_1 is -H; $-\text{NO}_2$; $-\text{CN}$; straight chained or branched C_1 -C- alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 -C-cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; $-\text{N}(\text{R}_3)_2$; $-\text{OR}_3$; $-(\text{CH}_2)_p\text{OR}_3$; $-\text{COR}_3$; $-\text{CO}_2\text{R}_3$; $-\text{CON}(\text{R}_3)_2$; or $\text{CO}_2(\text{CH}_2)_n\text{V}$;

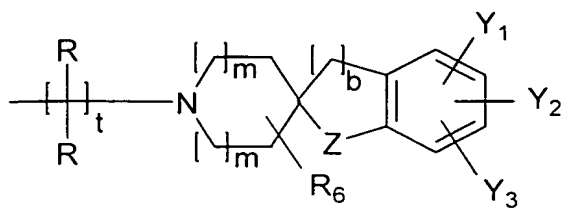
wherein R_2 is -H; straight chained or branched C_1 - C_7 alkyl, hydroxyalkyl, alkoxyalkyl, aminoalkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 - C_7 cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl; C_3 - C_{10} cycloalkyl- C_1 - C_{10} -alkyl, C_3 - C_{10} cycloalkyl- C_1 - C_{10} -monofluoroalkyl or C_3 - C_{10} cycloalkyl- C_1 - C_{10} -polyfluoroalkyl; $-\text{CN}$; $-\text{CH}_2\text{XR}_3$, $-\text{CH}_2\text{X}(\text{CH}_2)_p\text{NHR}_3$, $-(\text{CH}_2)_n\text{NHR}_3$, $-\text{CH}_2\text{X}(\text{CH}_2)_p\text{N}(\text{R}_3)_2$, $-\text{CH}_2\text{X}(\text{CH}_2)_p\text{N}_3$, $-\text{CH}_2\text{X}(\text{CH}_2)_p\text{NHCXR}_5$; $-\text{OR}_3$; or wherein R_1 and R_2 together form a lactone ring;

wherein each R_3 is independently -H; straight chained or branched C_1 - C_7 alkyl, monofluoroalkyl or polyfluoroalkyl; straight chained or branched C_2 - C_7 alkenyl or alkynyl; C_3 -C-cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;

wherein R_4 is

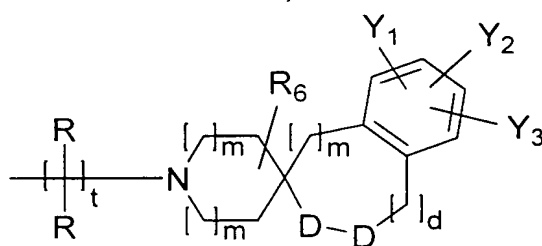


(iii)



5

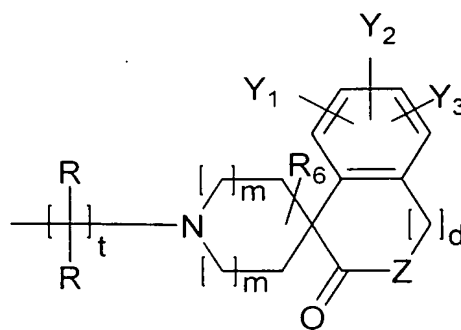
(iv)



10

15

(v)

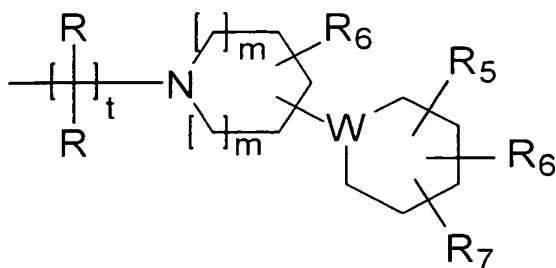


20

25

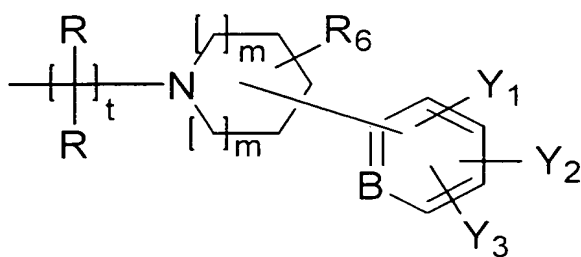
(vi)

5



(vii)

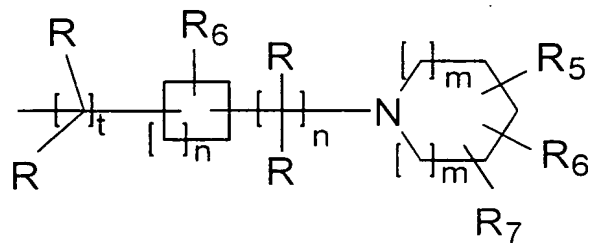
10



15

(viii)

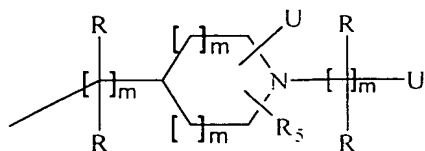
20



25

(ix)

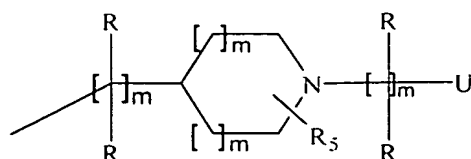
30



; or

35

(x)



wherein each R is independently -H; -F; straight chained
or branched C₁-C₇ alkyl, monofluoroalkyl or
polyfluoroalkyl; straight chained or branched C₂-C-
alkenyl or alkynyl; -N(R₃)₂; -NO₂; -CN; -CO₂R₃; -OR₃; or
5 -CN(R₃)₂;

wherein B is N or CY₄;

wherein each D is independently C(R₃)₂; O; S; NR₃; CO; or
10 CS;

wherein each U is independently aryl or heteroaryl,
optionally substituted with one or more F; Cl; Br; I;
COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃;
15 (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained or branched C₁-C₇
alkyl, monofluoroalkyl, polyfluoroalkyl, aminoalkyl, or
carboxamidoalkyl; straight chained or branched C₂-C₇
alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or
20 cycloalkenyl;

wherein V is C(R₅)₂; CR₅R₆; NR₅ or NR₆;

wherein W is CR₅; CR₆ or N;

25

wherein Z is S; O; C(R₃)₂; or NR₃;

wherein each R₅ is -H; -NO₂; -N₃; -CN; straight chained or
branched C₁-C₇ alkyl, monofluoroalkyl or polyfluoroalkyl;
30 straight chained or branched C₂-C₇ alkenyl or alkynyl; C₃-
C- cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl
or cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃;
or -CON(R₃)₂; -XCOR₈; or aryl or heteroaryl, wherein the
aryl or heteroaryl is optionally substituted with one or
35 more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂;

-N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; -XCOR₈; straight
chained or branched C₁-C₇ alkyl, monofluoroalkyl,
polyfluoroalkyl, or aminoalkyl; straight chained or
branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,
5 monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein each R₆ is independently -H; straight chained or
branched C₁-C₇ alkyl, hydroxyalkyl, aminoalkyl, alkoxyalkyl,
10 monofluoroalkyl or polyfluoroalkyl; straight chained or
branched C₂-C₇ alkenyl or alkynyl; C₃-C₇ cycloalkyl,
monofluorocycloalkyl, polyfluorocycloalkyl or cycloalkenyl;
-N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; or
-CON(R₃)₂;

15 wherein R₇ is -H; aryl or heteroaryl, optionally
substituted with one or more F; Cl; Br; I; COR₃; CO₂R₃;
-CON(R₃)₂; CN; -NO₂; -N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃;
(CH₂)_qSR₃; -XCOR₈; straight chained or branched C₁-C₇
20 alkyl, monofluoroalkyl, polyfluoroalkyl, or aminoalkyl;
straight chained or branched C₂-C₇ alkenyl, C₂-C₇ alkynyl;
C₃-C₇ cycloalkyl, monofluorocycloalkyl,
polyfluorocycloalkyl or cycloalkenyl;

25 wherein R₈ is -H; straight chained or branched C₁-C₇
alkyl, monofluoroalkyl or polyfluoroalkyl; straight
chained or branched C₂-C₇ alkenyl or alkynyl; C₃-C₇
cycloalkyl, monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl; -N(R₃)₂; -OR₃; -(CH₂)_pOR₃; -COR₃; -CO₂R₃; or
30 -CON(R₃)₂; aryl or heteroaryl, optionally substituted with
one or more F; Cl; Br; I; COR₃; CO₂R₃; -CON(R₃)₂; CN; -NO₂;
-N(R₃)₂; -OR₃; -SR₃; (CH₂)_qOR₃; (CH₂)_qSR₃; straight chained
or branched C₁-C₇ alkyl, monofluoroalkyl, polyfluoroalkyl,
aminoalkyl, or carboxamidoalkyl; straight chained or
35 branched C₂-C₇ alkenyl, C₂-C₇ alkynyl; C₃-C₇ cycloalkyl,

monofluorocycloalkyl, polyfluorocycloalkyl or
cycloalkenyl;

wherein b is 1 or 2;

5

wherein d is an integer from 0 to 2 inclusive;

wherein each m is independently an integer from 0 to 3
inclusive;

10

wherein each n is independently an integer from 0 to 5
inclusive;

15

wherein each p is independently an integer from 1 to 7
inclusive;

wherein q is an integer from 1 to 3 inclusive;

20

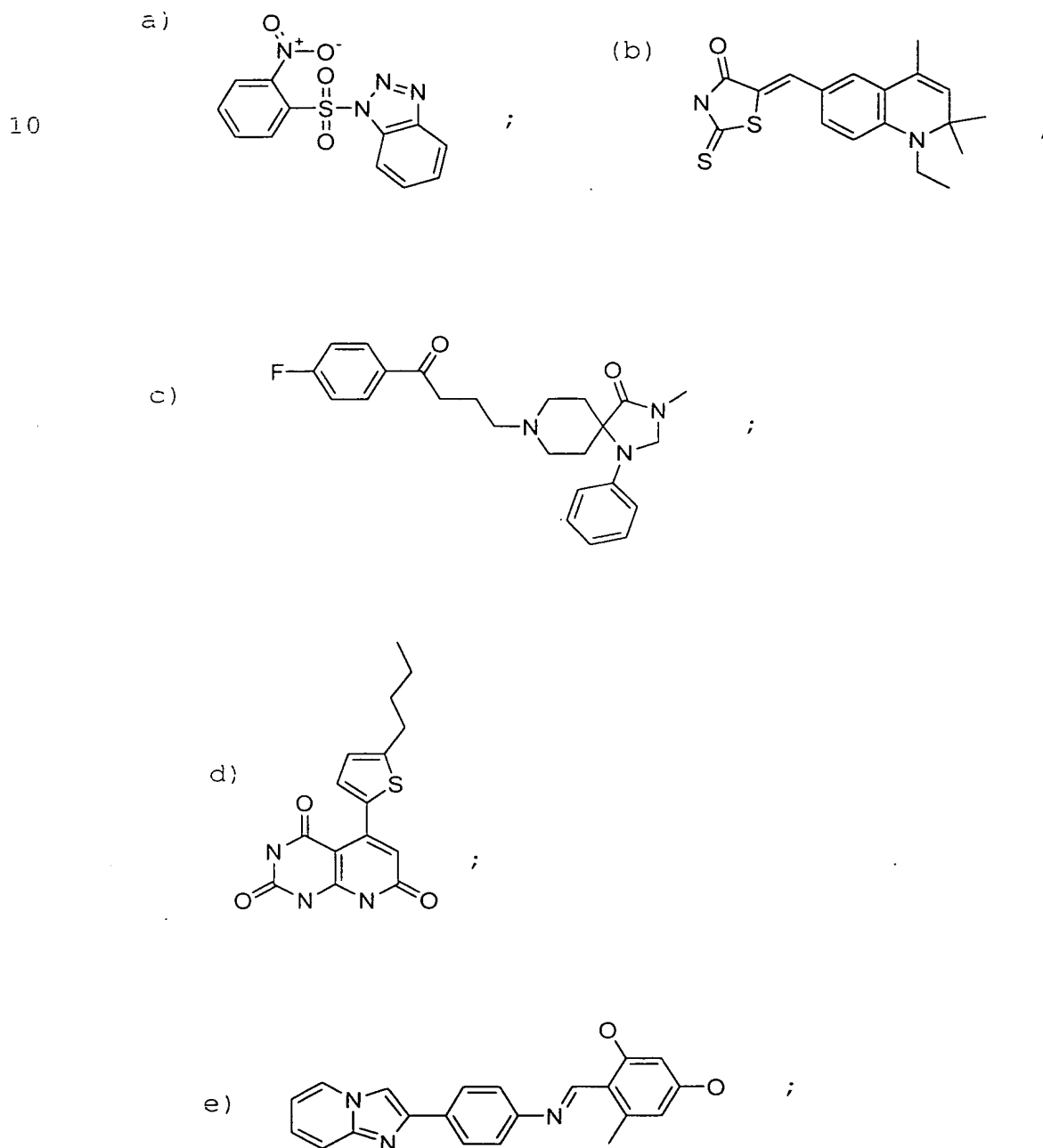
wherein t is an integer from 2 to 6 inclusive;

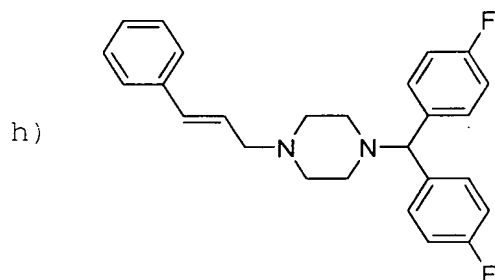
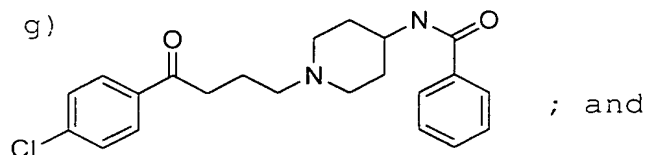
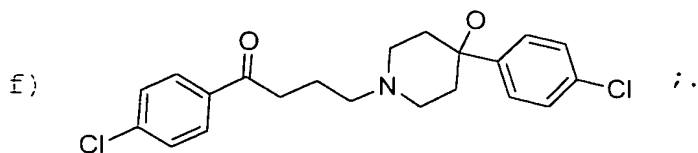
or a pharmaceutically acceptable salt thereof.

25

In addition, the present invention provides a method of
treating a subject suffering from depression and/or anxiety
which comprises administering to the subject a compound of
the aforementioned formula in an amount effective to treat
the subject's depression and/or anxiety.

This invention also provides a method of modifying feeding behavior of a subject which comprises administering to the subject an amount of a compound effective to decrease the consumption of food by the subject wherein the compound is selected from the group consisting of:





This invention further provides a method of modifying feeding behavior of a subject which comprises administering to the subject an amount of a compound of the present invention effective to decrease the consumption of food by the subject.

This invention also provides a method of treating a feeding disorder in a subject which comprises administering to the subject an amount of a compound of the present invention effective to decrease the consumption of food by the subject. In an embodiment of the present invention, the feeding disorder is bulimia, obesity or bulimia nervosa. In a further embodiment, the subject is a vertebrate, a mammal, a human or a canine. In yet another embodiment, the compound is administered in combination with food.

In the subject invention a "therapeutically effective amount" is any amount of a compound which, when administered to a subject suffering from a disease against which the compounds are effective, causes reduction, remission, or regression of the disease.

One skilled in the art will readily appreciate that appropriate biological assays will be used to determine the therapeutic potential of the claimed compounds for treating the above noted disorders.

Optimal dosages to be administered may be determined by those skilled in the art, and will vary with the particular compound in use, the strength of the preparation, the mode of administration, and the advancement of the disease condition. Additional factors depending on the particular subject being treated will result in a need to adjust dosages, including subject age, weight, gender, diet, and time of administration.

This invention further provides compositions which need not be pharmaceutical as that term is understood in the art. Such compositions comprise a compound in accordance with the subject invention in an amount effective to antagonize an MCH1 receptor and a suitable carrier.

Still further, the invention provides a method of agonizing and/or antagonizing an MCH1 receptor which comprises contacting the receptor, e.g. *in vitro* or *in vivo*, with an amount of a compound of this invention effective to agonize and/or antagonize the receptor.

This invention will be better understood from the Experimental Details which follow. However, one skilled in

the art will readily appreciate that the specific methods and results discussed are merely illustrative of the invention as described more fully in the claims which follow thereafter.

Experimental Section

I. Synthetic Methods for Examples

General Methods: All reactions (except for those done by
5 parallel synthesis reaction arrays) were performed under an
Argon atmosphere and the reagents, neat or in appropriate
solvents, were transferred to the reaction vessel via
syringe and cannula techniques. The parallel synthesis
10 reaction arrays were performed in vials (without an inert
atmosphere) using J-KEM heating shakers (Saint Louis, MO).
Anhydrous solvents were purchased from Aldrich Chemical
Company and used as received. The examples described in the
patent (1-37) were named using ACD/Name program (version
15 2.51, Advanced Chemistry Development Inc., Toronto,
Ontario, M5H2L3, Canada). Unless otherwise noted, the ^1H
and ^{13}C NMR spectra were recorded at 300 and 75 MHz (QE
Plus) with CDCl_3 as solvent and tetramethylsilane as
internal standard. s = singlet; d = doublet; t = triplet;
q = quartet; p = pentet; sextet; septet; br = broad; m =
20 multiplet. Elemental analyses were performed by Robertson
Microlit Laboratories, Inc. Unless otherwise noted, mass
spectra were obtained using low-resolution electrospray
(ESMS) and MH^+ is reported. Thin-layer chromatography (TLC)
was carried out on glass plates precoated with silica gel
25 60 F254 (0.25 mm, EM Separations Tech.). Preparative
thin-layer chromatography was carried out on glass sheets
precoated with silica gel GF (2 mm, Analtech). Flash
column chromatography was performed on Merck silica gel 60
(230 - 400 mesh). Melting points (mp) were determined in
30 open capillary tubes on a Mel-Temp apparatus and are
uncorrected.

Procedures for the Synthesis of the Dihydropyrimidine
Intermediates

5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-
OXO-6- (3,4-DIFLUOROPHENYL)-PYRIMIDINE: To a stirring
mixture of methyl 4-methoxyacetoacetate (50.0 g, 0.342
mol), 3,4-difluorobenz-aldehyde (51.4 g, 0.362 mol), and
5 urea (31.6 g, 0.527 mole) in THF (300 mL) at room
temperature were added copper(I) oxide (5.06 g, 0.035 mole)
and acetic acid (2.05 mL), sequentially, followed by
dropwise addition of boron trifluoride diethyl etherate
(56.0 mL, 0.442 mole). The mixture was stirred and
10 refluxed for 8 h, whereupon TLC (1/1 EtOAc/hexanes)
analysis indicated completion of the reaction. The reaction
mixture was cooled and poured into a mixture of ice and
sodium bicarbonate (100 g) and the resulting mixture was
filtered through Celite. The Celite pad was washed with
15 dichloromethane (400 mL). The organic layer was separated
from the filtrate and the aqueous layer was extracted with
more dichloromethane (3 X 300 mL). The combined organic
extracts were dried (sodium sulfate) and the solvent
evaporated. The crude product was purified by flash column
20 (ethyl acetate/hexanes, 1/1; then ethyl acetate), giving
the product as pale yellow foam, which on trituration with
hexane became white powder (103 g, 97%). ¹H NMR δ 3.48 (s,
3H), 3.65 (s, 3H), 4.65 (s, 2H), 5.39 (s, 1H), 6.60 (br s,
1H, NH), 7.00 - 7.20 (m, 3H), 7.72 (br s, 1H, NH).

25

(+)-5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-
OXO-6- (3,4-DIFLUOROPHENYL)-PYRIMIDINE: The racemic
intermediate 5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-
30 tetrahydro-2-oxo-6- (3,4-difluorophenyl)pyrimidine was
resolved by chiral HPLC. [Chiralcel OD 20 X 250 mm
#369-703-30604; λ 254 nm; hexanes/ethanol 90/10; 85 mg
per injection; retention time of the desired enantiomer:
16.94 min., the first enantiomer peak to elute], giving
35 (+) - 5 - methoxycarbonyl - 4 - methoxymethyl -

1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-pyrimidine (40-42 wt% isolation of the desired enantiomer from the racemate); $[\alpha]_D = + 83.8$ ($c = 0.5$, chloroform). The (-)-isomer was also isolated as the later eluting fraction from the chiral chromatography column.

(+)-5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-OXO- 6-(3,4-DIFLUOROPHENYL)-1-[(4-NITROPHENYLOXY)

CARBONYL]PYRIMIDINE: To a solution of

(+)-5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-pyrimidine (1.98 g, 6.34 mmol) in anhydrous THF (20 mL) at -78 °C under argon atmosphere, a solution of lithium hexamethyldisilazide in THF (1M, 18.0 mL, 18.0 mmol) was added over 2-3 min. and the mixture was stirred for 10 min. This solution was added over 6 min., via a cannula, to a stirred solution of 4-nitrophenyl chloroformate (4.47 g, 22.2 mmol) in THF (20 mL) at -78 °C. Stirring was continued for 10 min. and the mixture was poured onto ice (50 g) and extracted with chloroform (2 X 50 mL). The combined extracts were dried (sodium sulfate) and the solvent was evaporated. The residue was purified by flash column chromatography (hexanes/ethyl acetate, 4/1 to 3.5/1) as the eluent. The product was obtained as yellow syrup which upon trituration with hexanes became a white powder (2.40 g, 79%): ^1H NMR δ 3.52 (s, 3H), 3.74 (s, 3H), 4.65-4.80 (q, $J=16.5$ Hz, 2H), 6.32 (s, 1H), 7.10-7.30 (m, 4H), 7.36 (d, $J=9$ Hz, 2H), 8.27 (d, $J=9$ Hz, 2H).

BENZYL 3-[(3,4-DIFLUOROPHENYL)METHYLENE]-4-OXOPENTANOATE:

A solution of benzyl propionylacetate (36.3 g, 176 mmol), 3,4-difluorobenzaldehyde (25.0 g, 176 mmol), piperidine (0.86 mL, 9.0 mmol) and acetic acid (0.49 mL, 9.0 mmol) was refluxed with removal of water using a Dean-Stark apparatus

for 5 h. The solvent was removed *in vacuo* and the residue was dissolved in EtOAc. The reaction mixture was washed with water (100 mL), followed by brine (100 mL) and dried over anhydrous Na₂SO₄. The solvent was evaporated, giving a pale yellow syrup (60.2 g). The product was used in the next step without further purification.

5-(BENZYLOXYCARBONYL)-1,6-DIHYDRO-2-METHOXY-4-ETHYL-6-(3,4-DI-FLUOROPHENYL)PYRIMIDINE: A suspension of benzyl 3-[(3,4-di-fluorophenyl)methylene]-4-oxopentanoate (16.0 g, 48.0 mmol), O-methylisourea hydrogen sulfate (16.7 g, 97.0 mmol) and NaHCO₃ (16.3 g, 130 mmol) in DMF (190 mL) was stirred at 70 °C for 20 h. After cooling to room temperature, the mixture was filtered and the filtrate was diluted with EtOAc (300 mL) and then washed with water (4X100 mL), brine (200 mL) and dried over Na₂SO₄. After removal of solvent, the residue was purified by column chromatography (EtOAc/Hexane, 1/9 to 3/7), giving the title compound as a colorless oil (10.6 g, 58%). The NMR analysis showed it to be a mixture of amine/imine tautomers and was used as is in the next step.

5-(BENZYLOXYCARBONYL)-4-ETHYL-1,6-DIHYDRO-2-METHOXY-6-(3,4-DI-FLUOROPHENYL)-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE: To a stirring solution of 5-(benzyloxycarbonyl)-1,6-dihydro-2-methoxy-4-ethyl-6-(3,4-difluorophenyl)pyrimidine (17.0 g, 44.0 mmol) and 4-dimethylaminopyridine (7.00 g, 57.3 mmol) in CH₂Cl₂ (200 mL) was added 4-nitrophenyl chloroformate as a powder (11.5 g, 57.1 mmol) at room temperature. The reaction mixture was stirred for 12 h and then the solvent was removed *in vacuo*. The residue was purified by chromatography (EtOAc/Hexane, 1 / 9 to 3 / 7) , g i v i n g 5-(benzyloxycarbonyl)-4-ethyl-1,6-dihydro-2-methoxy-

6-(3,4-difluorophenyl)-1-[(4-nitrophenoxy)carbonyl]pyr-
imidine as a colorless viscous oil (12.6 g, 50%). ¹H NMR d
1.24 (t, J=7.2 Hz, 3H), 2.81-2.98 (m, 3H), 3.97 (s, 3H),
5.14 (ABq, A=5.08, B= 5.20, J= 12.3 Hz, 2H), 6.28 (s,
5 3H), 7.03-7.29 (m, 8H), 7.35 (d, J=9.2 Hz, 2H), 8.26 (d,
J=9.2 Hz, 2H).

5-(BENZYLOXYCARBONYL)-4-ETHYL-1,6-DIHYDRO-1-{N-[1-PHENYL]
ETHYL}}-CARBOXAMIDO-2-METHOXY-6-(3,4-DIFLUOROPHENYL)

10 PYRIMIDINE: To a stirred mixture of
5-(benzyloxycarbonyl)-4-ethyl-1,6-dihydro-2-
methoxy-6-(3,4-difluorophenyl)-1-[(4-nitrophenoxy)carbo-
nyl]pyr-imidine (12.6 g, 22.9 mmol) in THF (150 mL) was
added a solution of R-(+)- α -methyl benzylamine (3.53 mL,
15 27.1 mmol) at room temperature. The stirring was continued
for 12 h and the solvent was removed *in vacuo*. The yellow
residue was dissolved in chloroform (200 mL) and was washed
with 10% K₂CO₃ solution (2x30 mL). The organic layer was
dried over Na₂SO₄, filtered and solvent was removed *in*
20 *vacuo*. The resulting mixture of diastereomers was
separated by column chromatography (petroleum ether/ether,
9/1 to 4/1). The first major product to elute was
(+)-5-(benzyloxycarbonyl)-4-ethyl-
1,6-dihydro-1-{N-[1-phenyl]-ethyl}}carboxamido-2-
25 methoxy-6-(3,4-difluorophenyl)pyrimidine. Colorless oil;
R_f= 0.31 (petroleum ether/ether, 4/1); yield: 3.8 g (31%);
[α]_D = +267.05 (c = 0.76, CHCl₃); ¹H NMR d 1.22 (t, J=7.5 Hz,
3H), 1.52 (d, J=6.9 Hz, 3H), 2.88 (q, J=6.0 Hz, 2H), 3.99
(s, 3H), 4.99 (m, 1H), 5.09 (ABq, A=5.00, B= 5.19, J=
30 12.6 Hz, 2H), 6.66 (s, 1H), 6.99-7.36 (m, 13H). The second
major product to elute was
(-)-5-(benzyloxycarbonyl)-4-ethyl-1,6-dihydro-1-{N-
[2-phenyl]ethyl}}carboxamido-2-methoxy-6-(3,4-difluorophe-
nyl)pyr-imidine. Colorless oil; R_f= 0.22 (petroleum

ether/ether, 4/1); yield: 3.20 g (26%); $[\alpha]_D^{25} = -146.89$ ($c = 0.38$, CHCl_3); $^1\text{H NMR}$ δ 1.22 (t, $J=7.2$ Hz, 3H), 1.49 (d, $J=6.6$ Hz, 3H), 2.88 (q, $J=6.0$ Hz, 2H), 3.94 (s, 3H), 5.03 (m, 1H), 5.11 (ABq, $A=5.02$, $B=5.19$, $J=12.6$ Hz, 2H), 6.68 (s, 1H), 6.91-7.34 (m, 13H).

(+)-5-(BENZYLOXYCARBONYL)-1,6-DIHYDRO-2-METHOXY-4-ETHYL-6-(3,4-DI-FLUOROPHENYL)PYRIMIDINE: To a stirred solution of (+)-5-(benzyloxycarbonyl)-4-ethyl-1,6-dihydro-1-{N-[2-phenyl)ethyl]}carbox-amido-2-methoxy-6-(3,4-difluorophenyl)pyrimidine (1.00 g, 1.83 mmol) in toluene (10 mL) was added 1,8-diazabicyclo[5,4,0]-undec-7-ene (0.120 mL, 0.810 mmol) at room temperature and the resulting solution was heated at reflux temperature for 5 h and then stirred for 12 h at room temperature. The solvent was evaporated and the residue was purified by flash column (EtOAc/Hexanes, 1/3), giving (+)-5-(benzyloxycarbonyl)-1,6-dihydro-2-methoxy-4-ethyl-6-(3,4-difluorophenyl)pyrimidine (0.560 g, 77%).

(+)-5-(BENZYLOXYCARBONYL)-4-ETHYL-1,6-DIHYDRO-2-METHOXY-6-(3,4-DI-FLUOROPHENYL)-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE: To a stirring solution of (+)-5-(benzyloxycarbonyl)-1,6-dihydro-2-methoxy-4-ethyl-6-(3,4-difluorophenyl)pyrimidine (17.0 g, 44.0 mmol) and 4-dimethylaminopyridine (6.99 g, 57.3 mmol) in CH_2Cl_2 (200 mL) was added 4-nitrophenyl chloroformate (11.6 g, 57.3 mmol) at room temperature. The reaction mixture was stirred for 12 h and then the solvent was removed in vacuo. The residue was purified by chromatography (EtOAc/Hexane, 1/9 to 3/7), giving (+)-5-(benzyloxycarbonyl)-4-ethyl-1,6-dihydro-2-methoxy-6-(3,4-difluorophenyl)-1-[(4-nitrophenyloxy)carbonyl]pyrimidine as a viscous colorless oil (19.3 g,

7631.

5-METHYLBENZFUROXAN: 4-Methyl-2-nitroaniline (100 g, 0.650 mol) was suspended in saturated methanolic sodium hydroxide solution (1.50 L). This suspension was cooled (5 C) and aqueous sodium hypochlorite until the red color disappeared. The resulting fluffy yellow precipitate was filtered, washed with cold water and recrystallized from ethanol, giving 5-methylbenzfuroxan (88.2 g, 89 % yield) as a pale yellow solid: ^1H NMR δ 2.39 (s, 3 H), 6.90-7.40 (br m, 3 H).

5-METHYLBENZOFURAZAN: To 5-Methylbenzfuroxan (88.2 g, 0.590 mol) in refluxing EtOH (75 mL) was added dropwise P(OEt)₃ (150 mL). Heating was continued at reflux temperature for 1 h. The solvent was removed in vacuo and the residue was shaken with water (200 mL) and allowed to stand overnight at (0-5 C). The resulting brown solid was filtered, washed with water. The crude product was purified by flash chromatography, giving 5-methylbenzofurazan (70.0 g, 87 %) as white needles; ^1H NMR δ 2.41 (s, 1 H), 7.19 (dd, J=9.3, 1.1 Hz, 1 H), 7.48 (d, J=1.1 Hz, 1 H), 7.66 (d, J=9.3 Hz, 1 H).

5-DIBROMOMETHYLBENZOFURAZAN: An anhydrous solution of 5-methylbenzofurazan (70.0 g, 0.520 mol), N-bromosuccinamide (325 g), and benzoyl peroxide (0.50 g) in carbon tetrachloride (1.5 L) was heated at reflux temperature with stirring for 30 h. The reaction mixture was washed with water (2 X 500 mL), dried (NaSO₄), and the solvent was removed in vacuo. The residue was chromatographed (EtOAc/hexane, 1/150), giving 122 g (80%) of the title compound as a white solid: ^1H NMR δ 6.69 (s, 1 H), 7.69 (d, J=9.6 Hz, 1 H), 7.77 (s, 1 H), 7.89 (d, J=9.6 Hz, 1 H).

5-FORMYLBENZOFURAZAN: AgNO₃ (163 g) in 2 L of water was added to a refluxing mixture of dibromomethylbenzofurazan (122 g, 418 mmol) in EtOH (1 L). Heating at reflux temperature was continued for 2 h. The mixture was cooled, the precipitated AgBr was removed by filtration through Celite, and the solvent was concentrated. The resulting solution was extracted with toluene (10 X 100 mL), dried over magnesium sulfate, and the solvent was removed in vacuo. The residue was chromatographed (EtOAc/hexane, 1/125), giving the title aldehyde (48.2 g, 78%) as a white solid: ¹H NMR δ 7.92 (m, 2H), 8.39 (s, 1 H), 10.10 (s, 1 H).

METHYL 2-((BENZOFURAN-5-YL)METHYLENE)-3-OXOBUTYRATE: A mixture of 5-formylbenzofurazan (0.60 g, 4.1 mmol), methyl acetoacetate (0.52 g, 4.5 mmol), piperidine (0.019 g, 0.23 mmol), and acetic acid (0.014 g, 0.23 mmol) in benzene (30 mL) was heated at reflux temperature (equipped with a Dean-Stark trap) for 8 h. Benzene was evaporated in vacuo, the residue was dissolved in ethyl acetate (80 mL) and washed with brine (50 mL), saturated potassium bisulfate solution (50 mL), and saturated sodium bicarbonate solution. The ethyl acetate solution was dried over magnesium sulfate, the solvent removed under reduced pressure and the residue was purified by column chromatography (EtOAc/hexane, 1/9 to 3/20). The desired product was obtained as oil (0.98 g, 98%) and was used in the next step without any further characterization.

30

6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYLPYRIMIDINE: A mixture of methyl 2-((benzofuran-5-yl)-methylene)-3-oxobutyrates (1.02 g, 4.10 mmol), O-methylisourea hydrogen sulfate (1.06 g, 6.20

mmol), and NaHCO_3 (1.30 g, 16.4 mmol) in DMF (15 mL) was stirred and heated at 70 °C for 16 h. The mixture was cooled, diluted with EtOAc (50 mL) and washed with water (5X 50 mL), brine (50 mL) and dried over magnesium sulfate. The solvent was evaporated and the crude product was purified by flash chromatography (EtOAc/hexane, 1/9 to 1/5), giving the desired product as an oil (0.520 g, 43%): $^1\text{H-NMR}$ δ 2.38 and 2.42 (2 s, 3 H), 3.60 and 3.66 (2 s, 3 H), 3.74 and 3.82 (2 s, 3 H), 5.53 and 5.68 (2 s, 1 H), 6.31 and 6.32 (br s, 1 H), 7.0-7.8 (m, 3 H).

6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE: To a solution of 6-(benzofuran-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methylpyrimidine (0.485 g, 1.6 mmol) and 4-dimethylaminopyridine (0.200 g, 1.64 mmol) in CH_2Cl_2 (20 mL) at 0-5 °C was added 4-nitrophenyl chloroformate (0.307 g, 1.52 mmol). The mixture was then allowed to warm to room temperature. After 12 h, the solvent was evaporated and the residue was purified by flash chromatography (EtOAc/hexane, 1/9 to 3/20), giving the desired product as white crystals (0.665 g, 89%); mp 180-183 °C; $^1\text{H NMR}$ δ 2.54 (s, 3 H), 3.75 (s, 3 H), 3.98 (s, 3 H), 6.37 (s, 1 H), 7.40 (d, $J=9.3$ Hz, 2 H), 7.52 (d, $J=9.0$ Hz, 1 H), 7.68 (s, 1 H), 7.84 (d, $J=9.0$ Hz, 1 H), 8.32 (d, $J=9.3$ Hz, 2 H).

(+) and (-)-6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-1-[N-(S)-1-(1-PHENYLETHYL)]-4-METHYLPYRIMIDINE: A solution of 6-(benzofurazan-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)carbonylpyrimidine (800 mg, 1.71 mmol)

and (S)-(-)- α -methylbenzylamine (269 mg, 2.22 mmol) in THF (50 mL) was stirred at room temperature for 12 h. The THF was removed *in vacuo* and the residue was dissolved in EtOAc (100 mL), washed by 10% aqueous K₂CO₃ solution (3x50 mL), brine (50 mL) and dried (Na₂SO₄). After removal of the solvent, the residue was purified by chromatography (EtOAc/hexane, 1/20 to 3/20), separating the two diastereomers. The isomers of 6-(benzofurazan-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-1-[N-(S)-1-(1-phenylethyl)]-4-methylpyrimidine were obtained as colorless oils. 1st Isomer (367 mg, 47.7%): $[\alpha]_D^{25} = +278$ (c=0.50, CHCl₃); ¹H NMR δ 1.54 (d, J=6.9 Hz, 3H), 2.45 (s, 3H), 3.68 (s, 3H), 3.99 (s, 3H), 5.02 (quintet, J=6.9 Hz, 1H), 6.71 (s, 1H), 6.89 (d, J=6.6 Hz, 1H), 7.2-7.9 (m, 8H). 2nd Isomer (205 mg, 26.6%): $[\alpha]_D^{25} = -81$ (c=0.43, CHCl₃); ¹H NMR δ 1.52 (d, J=6.6 Hz, 3H), 2.48 (s, 3H), 3.71 (s, 3H), 3.96 (s, 3H), 5.00 (quintet, J=6.6 Hz, 1H), 6.74 (s, 1H), 6.90 (d, J=6.5 Hz, 1H), 7.2-7.9 (m, 8H).

6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYLPYRIMIDINE: A solution of the 1st isomer of 6-(benzofurazan-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbon-yl-1-[N-(S)-1-(1-phenylethyl)]-4-methylpyrimidine (960 mg, 2.14 mmol) and 1,8-diazabicyclo[5,4,0]undec-7-ene (107 mg, 0.705 mmol) in toluene (50 mL) was stirred at 100 °C for 5 h. After cooling to room temperature, toluene was removed *in vacuo* and the residue was purified by chromatography (EtOAc/hexane, 1/9 to 3/7). 6-(Benzofurazan-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methylpyrimidine was obtained as a colorless oil (635 mg, 98.3%). ¹H NMR δ 2.38 (s, 3H), 3.66 (s, 3H), 3.74 (s, 3H), 5.68 (s, 1H), 6.32 (br s, 1H), 7.0-7.8 (m, 3H).

6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYL-1-(4-NITROPHENOXY)CARBONYLPYRIMIDINE: To a solution of 6-(benzofuran-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methylpyrimidine (0.485 g, 1.60 mmol) and 4-dimethylamino-pyridine (0.200 g, 1.60 mmol) in CHCl₃ (20 mL), at 0-5 °C, was added 4-nitrophenyl chloroformate (0.307 g, 1.52 mmol). After addition, the mixture was allowed to warm to room temperature. After 12 hours, the solvent was evaporated and the residue was purified by flash column chromatography (EtOAc/hexane, 1/9 to 3/20), giving the desired product as white crystals (0.665 g, 89%): mp 180-183 °C; ¹H NMR δ 2.54 (s, 3 H), 3.75 (s, 3 H), 3.98 (s, 3 H), 6.37 (s, 1 H), 7.40 (d, J = 9.3 Hz, 2 H), 7.52 (d, J = 9.0 Hz, 1 H), 7.68 (s, 1 H), 7.84 (d, J = 9.0 Hz, 1 H), 8.32 (d, J = 9.3 Hz, 2 H); [α]_D = +266 (c=2.70, CHCl₃).

METHYL 2-((3,4-DIFLUOROPHENYL)METHYLENE)-3-OXOBUTYRATE: A mixture of 3,4-difluorobenzaldehyde (14.2 g, 0.100 mol), methyl acetoacetate (12.2 g, 0.105 mol), piperidine (0.430 g, 5 mmol), and acetic acid (0.30 g, 5 mmol) in benzene (150 mL) was stirred and heated at reflux temperature (equipped with a Dean-Stark trap) for 8 h. The benzene was evaporated and the residue was dissolved in ethyl acetate (200 mL). The resulting solution was washed with brine (50 mL), saturated potassium bisulfate solution (50 mL), and saturated sodium bicarbonate solution. The ethyl acetate solution was dried over magnesium sulfate and the solvent was removed under reduced pressure. The residue was purified by column chromatography (EtOAc/hexane, 1/9 to 3/20), giving the desired product as a yellow oil (9.80 g, 41%) which was used in the subsequent step without any further characterization.

6-(3,4-DIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYLPYRIMIDINE: A mixture of methyl 2-((3,4-difluorophenyl)-methylene)-3-oxobutyrates (8.80 g, 36.3 mmol), O-methylisourea hydrogen sulfate (9.40 g, 54.6 mmol), and NaHCO₃ (12.3 g, 146 mmol) in DMF (30 mL) was heated at 70 °C with stirring for 16 h. The mixture was cooled, diluted with EtOAc (300 mL) and washed with water (5 X 300 mL), brine (300 mL), and dried over magnesium sulfate. The solvent was evaporated and the crude product was purified by flash chromatography (EtOAc/hexane, 1/9 to 3/7) as the gradient eluent, giving the desired product as an oil (3.82 g, 35%).

6-(3,4-DIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-METHOXYCARBONYL-4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE: 4-Nitrophenyl chloroformate (1.82 g, 9.04 mmol) was added to a solution of 6-(3,4-difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methylpyrimidine (2.82 g, 9.46 mmol) and 4-dimethylaminopyridine (1.16 g, 9.52 mmol) in CH₂Cl₂ (50 mL), at 0-5 °C and the mixture was then allowed to warm to room temperature. After 12 h, the solvent was evaporated and the residue was purified by flash chromatography (EtOAc/hexane, 1/9 to 3/20), giving the desired product as white crystals (3.72, 85%): mp 172-174 °C.

6-(3,4-DIFLUOROPHENYL)-1,2,3,6-TETRAHYDRO-2-OXO-5-METHOXYCARBONYL-4-METHYL-1-(4-NITROPHENOXY)CARBONYLPYRIMIDINE: Aqueous 6 N hydrochloric acid (10 mL) was added to a stirring solution of 6-(3,4-difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)carbonylpyrimidine (10.0 g) in THF (200 mL) at room temperature. The stirring was continued for 3 h. The solvent was evaporated and the residue was dried under vacuum, giving the desired product as a white powder (9.70

g, 100%): mp 185-186 °C.

(+)-1-(3-BROMO-PROPYLCARBAMOYL)-6-(3,4-DIFLUOROPHENYL)-4-METHYL-2-OXO-1,6-DIHYDRO-PYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER: A solution of 10% aqueous HCl (5 mL) was added to a stirring solution of (+)-6-(3,4-difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-[(4-nitrophenoxy)-carbonyl]pyrimidine (4.10 g, 9.10 mmol) in THF (20 mL) at room temperature and the resulting solution was stirred overnight. The THF was removed *in vacuo* and the resulting residue was extracted with EtOAc (3 X 20 mL), washed with brine (10 mL) and then dried over Na₂SO₄. The solvent was removed *in vacuo*, giving (+)-6-(3,4-di-fluorophenyl)-1,6-dihydro-2-oxo-5-methoxycarbonyl-4-methyl-1-[(4-nitrophenoxy)carbonyl]pyrimidine as a viscous oil (3.8 g, 8.5 mmol). The oil was dissolved in THF (20 mL) and 3-bromo-propylamine hydrobromide (2.33 g, 10.8 mmol) and NaHCO₃ (1.81 g, 21.5 mmol) were added. The resulting suspension was stirred at room temperature overnight. The THF was removed *in vacuo* and the resulting residue was dissolved in water (10 mL) and then extracted with EtOAc (3 X 20 mL). The EtOAc extracts were combined, dried over Na₂SO₄, filtered and the solvent was removed, giving (+)-1-(3-bromopropylcarbamoyl)-6-(3,4-difluorophenyl)-4-methyl-2-oxo-1,6-dihydropyrimidine-5-carboxylic acid methyl ester (3.28 g, 83%): ¹H NMR δ 2.05-2.15 (m, 2 H), 2.43 (s, 3 H), 3.40-3.56 (m, 4 H), 3.72 (s, 3 H), 6.69 (s, 1 H), 7.08-7.27 (m, 3 H), 7.57 (br s, 1 H), 8.84 (br t, 1 H). Anal. Calcd for C₂₁H₁₇N₃O₄ F₂Br: C, 45.76; H, 4.07; N, 9.42. Found: C, 45.70; H, 3.99; N, 9.16.

3-[(3,4,5-TRIFLUOROPHENYL)METHYLENE]-2,4-PENTANEDIONE: A stirring mixture of 3,4,5-trifluorobenzaldehyde (4.20 g,

26.2 mmol), 2,4-pentanedione (2.62 g, 26.2 mmol),
piperidine (0.430 g, 5.00 mmol) in benzene (150 mL) was
heated at reflux temperature (equipped with a Dean-Stark
trap) for 8 h. The benzene was evaporated and the yellow
5 oily residue, 2-((3,4,5-trifluorophenyl)methylene)-
2,4-pentanedione, was used in the next step without further
purification.

6-(3,4,5-TRIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-ACETYL-
10 4-METHYLPYRIMIDINE: A mixture of 2-((3,4,5-
trifluorophenyl)methylene)-2,4-pentanedione (26.2 mmol),
O-methylisourea hydrogen sulfate (3.22 g, 39.3 mmol), and
NaHCO₃ (6.6 g, 78.6 mmol) in EtOH (400 mL) was stirred and
heated at 95-100 °C for 6 h. The mixture was filtered and
15 the solid residue was washed with ethanol (100 mL). The
solvent was evaporated from the combined filtrates and the
crude product was purified by flash column chromatography
(EtOAc/hexane, 1/9 to 1/4), giving the desired product as
an oil (2.80 g, 36%).

20

6-(3,4,5-TRIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-ACETYL-
4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE:
4-Nitrophenyl chloroformate (1.89 g, 9.38 mmol) was added
to a solution of 6-(3,4,5-trifluorophenyl)-1,6-
25 dihydro-2-methoxy-5-acetyl-4-methylpyrimidine (2.80 g,
9.38 mmol) and pyridine (10 mL) in CH₂Cl₂ (200 mL) at 0-5 °C,
and the resulting mixture was allowed to warm to room
temperature. After 12 h, the solvent was evaporated and
the residue was purified by flash chromatography
30 (dichloro-methane/EtOAc, 1/9 to 3/20), giving the desired
product as a white powder (4.00 g, 92%).

6-(3,4,5-TRIFLUOROPHENYL)-1,2,3,6-TETRAHYDRO-2-OXO-5-ACETYL-
4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE: A
35 solution of 6 N aqueous HCl (4 mL) was added to a stirring

solution of 6- (3,4,5-trifluorophenyl)-1,6-dihydro-2-methoxy-5-acetyl-4-methyl- 1-[(4-nitrophenyloxy)carbonyl]pyrimidine (4.00 g, 8.63 mmol) in THF (100 mL) at 0-5 °C, and the mixture was allowed to warm to room temperature. After 2 h, solvent was evaporated and the product dried under vacuum. The product was obtained as a pure single component and used in the next step without any further purification (3.88 g, 100%).

10 Procedures for the Synthesis of the Piperidine Intermediates

(reference for the general procedure for Pd coupling of vinyl triflate and boronic acids or tributyl tin reagents: See, Wuston, Wise *Synthesis* (1991), 993)

15

TERT-BUTYL 4-([(TRIFLUOROMETHYL)SULFONYL]OXY)-

1,2,3,6-TETRA-HYDRO-1-PYRIDINECARBOXYLATE: *n*-Butyllithium (17.6 mL, 44.2 mmol, 2.5 M in hexanes) was added to a solution of diisopropyl amine (96.2 mL, 44.2 mmol) in 40 mL of dry THF at 0 °C and stirred for 20 minutes. The reaction mixture was cooled to -78 °C and tert-butyl 4-oxo-1-piperidinecarboxylate (40.0 mmol) in THF (40 mL) was added dropwise to the reaction mixture and stirred for 30 minutes. Tf₂NPh (15.0 g, 42.0 mmol) in THF (40 mL) was added dropwise to the reaction mixture and the mixture was stirred at 0 °C overnight. The reaction mixture was concentrated *in vacuo*, re-dissolved in hexanes/EtOAc (9/1), passed through a plug of alumina and washed with hexanes/EtOAc (9/1). The combined extracts were concentrated to yield 16.5 g of the desired product that was contaminated with a small amount of Tf₂ Nph. ¹H NMR δ 5.77 (s, 1 H), 4.05 (dm, 2 H, J=3.0 Hz), 3.63 (t, 2 H, J=5.7 Hz), 2.45 (m, 2 H), 1.47 (s, 9 H).

TERT-BUTYL 4-[3-(ACETYLAMINO)PHENYL]-1,2,3,6-

TETRAHYDRO-1-PYRIDINECARBOXYLATE: A mixture of saturated of aqueous Na_2CO_3 solution (25 mL), tert-butyl 4-[[trifluoromethyl)sulfonyl]oxy]-1,2,3,6-

5 tetrahydro-1-pyridine-carboxylate (20 mmol), 3-acetamidophenylboronic acid (30 mmol) and tetrakis-triphenylphosphine palladium (0) (1.15 g) and dimethoxyethane (40 mL) was heated at reflux temperature overnight. The organic layer of the cooled reaction
10 mixture was separated and the aqueous layer was washed with ethyl acetate (3X). The combined organic extracts were dried and concentrated *in vacuo*. The crude product was chromatographed, giving the desired product $^1\text{H NMR } \delta$ 8.11 (br s, 1 H), 7.57 (br s, 1 H), 7.41 (br δ , 1 H, $J=7.8$ Hz),
15 7.25 (apparent t, 1 H, $J=7.8$ Hz), 7.08 (br d, 1 H, $J=7.8$ Hz), 5.99 (b s, 1 H), 4.03 (br m, 2 H, $J=2.7$ Hz), 3.59 (t, 2 H, $J=5.7$ Hz), 2.46 (m, 2 H), 2.16 (s, 3 H), 1.49 (s, 9 H).

20 N1-[3-(1,2,3,6-TETRAHYDRO-4-PYRIDINYL)PHENYL]ACETAMIDE: A solution of 4 M HCl in dioxane (10 mL) was added to tert-butyl 4-[3-(acetylamino)phenyl]-1,2,3,6-tetrahydro-1-pyridinecarboxylate (8.25 mmol) in
25 dichloromethane (30 mL). The reaction mixture was stirred at room temperature overnight, concentrated *in vacuo*, giving the desired product as the hydrochloride salt (2.1 g). $^1\text{H NMR } \delta$ 7.41-7.00 (m, 4 H), 6.10 (br, 1 H), 3.55 (m, 2 H), 3.16 (t, 2 H, $J = 5.7$ Hz), 2.44 (m, 2 H), 2.19 (s, 3 H).

30

TERT-BUTYL N-(3-BROMOPROPYL)CARBAMATE: Prepared from 3-bromopropylamine hydrobromide and BOC_2O in the presence of base in dichloromethane: $^1\text{H NMR } \delta$ 5.07 (br, 1 H), 3.31 (t, 2 H, $J=6.6$ Hz), 3.12 (apparent br q, 2 H, $J=6.0$ Hz), 1.92

(p, 2 H, J=6.6 Hz), 1.30 (s, 9H).

REACTION OF N1-[3-(1,2,3,6-TETRAHYDRO-4-PYRIDINYL) PHENYL]
ACETAMIDE WITH TERT-BUTYL N-(3-BROMOPROPYL)CARBAMATE

5

TERT-BUTYL N-(3-{4-[3-(ACETYLAMINO) PHENYL]-

1,2,3,6-TETRAHYDRO- 1-PYRIDINYL}PROPYL)CARBAMATE: A

solution of N1-[3-(1,2,3,6- tetrahydro-4-pyridinyl)

10 phenyl]acetamide hydrochloride (8.24 mmol), tert-butyl

N-(3-bromopropyl)carbamate and potassium carbonate (33

mmol) in dry dioxane (30 mL) was heated at reflux

temperature overnight. The solids were removed by

filtration, the solution was concentrated *in vacuo* and the

product was chromatographed, giving the desired product

15 (110 mg). ¹H NMR δ 7.65 (s, 1 H), 6.98 (s, 1 H), 7.45 (d, 1

H, J=7.8 Hz), 7.16 (apparent t, 1 H, J=7.8 Hz), 7.10 (d, 1

H, J=7.8 Hz), 6.02 (s, 1 H), 5.23 (b, 1 H), 3.40 (b, 2 H),

3.30-1.80 (m, 10 H), 2.18 (s, 3 H), 1.45 (s, 9 H).

20 Deprotection of BOC:

N1-{3-[1-(3-AMINOPROPYL)-1,2,3,6-TETRAHYDRO-4-PYRIDINYL]P

HENYL}ACETAMIDE: A 1:1 solution of TFA:CH₂Cl₂ (5 mL) was

added to tert-butyl N-(3-{4-[3-(acetylamino)phenyl]-

1,2,3,6-tetrahydro-1- pyridinyl}propyl)carbamate in

25 dichloromethane (5 mL). The resulting solution was stirred

at room temperature for 1-3 days, saturated NaHCO₃ was

added until pH > 6, the organic layer was separated, and

dried *in vacuo*, giving the desired product (45 mg): ¹H NMR

δ 7.68 (br, 1 H), 7.35 (dm, 1 H, J=7.8 Hz), 7.25 (apparent

30 t, 1 H, J=7.8 Hz), 7.15 (dm, 1 H, J=7.8 Hz), 6.12 (m, 1 H),

3.22 (m, 2 H), 3.03 (t, 2 H, J=7.3 Hz), 2.78 (t, 2 H, J=5.5

Hz), 2.70-2.50 (m, 4 H), 2.10 (s, 3 H), 1.87 (p, 2 H, J=7.3

Hz).

TERT-BUTYL 4-[3-(ACETYLAMINO)PHENYL]-1-

PIPERIDINECARBOXYLATE: A mixture tert-butyl
4-[3-(acetylamino)phenyl]-1,2,3,6-tetra-hydro-1-
pyridinecarboxylate (710 mg) and 5% Pd/C (100 mg) in EtOH
5 (10 mL) was hydrogenated (balloon technique) at room
temperature overnight. The reaction mixture was passed
through a pad of Celite 545 and the pad of Celite was
washed with ethanol. The combined ethanol extracts were
concentrated and chromatographed, giving the desired
10 product (660 mg). ¹H NMR δ 7.80 (s, 1 H), 7.41-7.20 (m, 3
H), 6.94 (d, 1 H, J=7.5 Hz), 4.21 (m, 2 H), 2.75 (m, 2 H),
2.62 (m, 1 H), 2.16 (s, 3 H), 1.78 (m, 2 H), 1.56 (m, 2 H),
1.48 (s, 9 H).

15 N1-[3-(4-PIPERIDYL)PHENYL]ACETAMIDE: A solution of HCl in
dioxane (4N, 5 mL) was added to tert-butyl 4-[3-
(acetylamino)-phenyl]-1-piperidinecarboxylate (660 mg) in
dry dichloromethane (15 mL). The reaction mixture was
stirred at room temperature overnight and concentrated *in*
20 *vacuo*, giving the desired product (550 mg): mp 102-104 C;
¹H NMR δ 2.02 (d, J=13.2 Hz, 2H), 2.11-2.45 (m, 5H),
2.67-2.77 (m, 1H), 3.00-3.10 (m, 2H), 3.51 (d, J=10.5 Hz,
2H), 6.94 (d, J=7.5 Hz, 1H), 7.20-7.46 (m, 3H), 7.60 (s,
1H).

25 TERT-BUTYL N-(3-{4-[3-(ACETYLAMINO)PHENYL]
PIPERIDINO}PROPYL)-CARBAMATE: A solution of
N1-[3-(4-piperidyl)phenyl]acetamide (550 mg, 0.210 mmol),
tert-butyl N-(3-bromopropyl)-carbamate (550 mg, 0.230
30 mmol), K₂CO₃ (1.10 g, 0.890 mmol), diisopropylethyl amine
(1.50 mL) and a few crystals of KI in dioxane (20 mL) was
heated at reflux temperature for 2 days. The precipitated
salts were removed by filtration, concentrated *in vacuo* and
the crude product was chromatographed, giving the desired

product (340 mg). ^1H NMR δ 8.15 (s, 1 H), 7.47-7.44 (m, 2 H), 7.22 (t, 1 H, $J=7.8$ Hz), 6.94 (d, 1 H, $J=7.8$ Hz), 5.53 (b, 1 H), 3.23 (b, 6 H), 2.80-1.60 (m, 9 H), 2.20 (s, 3 H), 1.45 (s, 9 H).

5

N1-{3-[1-(3-AMINOPROPYL)-4-PIPERIDYL]PHENYL}ACETAMIDE: TFA (1.0 mL) was added to a solution of tert-butyl N-(3-{4-[3-(acetyl-amino)phenyl]piperidino} propyl)carbamate (340 mg) in dry dichloromethane (10 mL) and stirred at room temperature for 5 h. A 10% aqueous solution of KOH was added to the reaction mixture until pH > 6 and then the dichloromethane was removed *in vacuo*. The aqueous layer was frozen and lyophilized, giving a solid which was then extracted with methanol. Removal of methanol gave the desired product (120 mg) as an oil. ^1H NMR δ 8.56 - 8.46 (s, 1H), 7.43 - 7.30 (m, 2H), 7.23 - 7.16 (apparent t, 1H, $J=7.5$ Hz), 6.95 - 6.92 (m, 1H), 3.03 - 2.99 (m, 2H), 2.77 - 2.73 (t, 2H, $J = 6.6$ Hz), 2.50-1.60 (m, 10 H), 2.13 (s, 3 H).

10
15
20

1-BENZYL-4-HYDROXY-4-(4-FLUORO-2-METHYLPHENYL)PIPERIDINE: ^1H NMR δ 7.40-7.26 (m, 5 H), 6.91-6.76 (m, 3 H), 3.57 (s, 2 H), 2.83- 2.72 (m, 2 H), 2.61 (s, 3 H), 2.58-2.43 (m, 2 H), 2.23-2.12 (m, 2 H).

25

1-BENZYL-4-(4-FLUORO-2-METHYLPHENYL)-1,2,3,6-TETRAHYDROPYRIDINE: ^1H NMR δ 7.41-7.26 (m, 5 H), 7.05 (dd, 1 H, $J=6.0$, 8.1 Hz), 6.87-6.80 (m, 2 H), 5.52-5.50 (m, 2 H), 3.65 (s, 2 H), 3.13 (q, 2 H, $J=3.3$ Hz), 2.69-2.66 (t, 2 H, $J=5.1$ Hz), 2.35-2.31 (m, 2 H), 2.27 (s, 3 H).

30

4-(4-FLUORO-2-METHYLPHENYL)PIPERIDINE: ^1H NMR δ 7.17 (t, 1

H, J=7.2 Hz), 6.83-6.80 (m, 2 H), 3.22 (m, 2 H), 2.81-2.73 (m, 2 H), 2.66 (br s, 1 H), 2.33 (s, 3 H), 1.80-1.60 (m, 4 H).

5 1-BENZYL-4-(3,4,5-TRIFLUOROPHENYL)-1,2,3,6-TETRAHYDROPIRIDINE: ^1H NMR δ 7.50-7.20 (m, 7 H), 5.67 (m, 1 H), 3.69 (s, 2 H), 3.19 (apparent q, 2 H, J=2.7 Hz), 2.75 (t, 2 H, J=5.7 Hz), 2.34 (m, 2 H).

10 4-(3,4,5-TRIFLUOROPHENYL)PIPERIDINE: mp 197-199 °C; ^1H NMR δ 2.05 (d, J=13.2 Hz, 2H), , 2.33 (dd, J=25.5 Hz, J=12.9 Hz, 2H), 3.06-3.23 (m, 3H), 3.73 (d, J=12.0 Hz, 2H), 6.94-7.04 (m, 2H).

15 4-(3,4,5-TRIFLUOROPHENYL)PIPERIDINE: ^1H NMR δ 7.20-6.80 (m, 2 H), 3.73 (m, 2 H), 3.14 (m, 3 H), 2.33 (m, 2 H), 2.05 (m, 2 H).

TERT-BUTYL N-3-[4-(3,4,5-TRIFLUOROPHENYL)PIPERIDINO]

20 PROPYL-CARBAMATE: ^1H NMR δ 6.91 (m, 2 H), 5.62 (b, 1 H), 4.31 (t, 2 H, J=5.4 Hz), 3.63 (m, 2 H), 3.39 (dt, 2 H, J=2.1, 6.0 Hz), 3.40-2.70 (m, 7 H), 2.46 (t, 2 H, J=6.9 Hz), 2.10-1.60 (m, 4 H), 1.45 (s, 9 H).

25 3-[4-(3,4,5-TRIFLUOROPHENYL)PIPERIDINO]-1-PROPANAMINE: ^1H NMR δ 6.93 (m, 2 H), 4.30 (b, 1 H), 3.36 (b, 1 H), 3.06 (m, 2 H), 2.77 (m, 2 H), 2.43 (m, 2 H), 2.20-1.40 (m, 9 H).

30 1-BENZYL-4-(5-FLUORO-2-METHOXYPHENYL)-4-PIPERIDINOL: ^1H NMR δ 7.40-6.80 (m, 8 H), 3.94 and 3.85 (s, 3 H), 3.61 and 3.58 (s, 2 H), 2.80-1.90 (m, 8 H).

1-BENZYL-4-(5-FLUORO-2-METHOXYPHENYL)-1,2,3,6-TETRAHYDROP

YRIDINE: ^1H NMR δ 7.40-6.70 (m, 8 H), 5.84 (m, 1 H), 3.77 (s, 3 H), 3.64 (s, 2 H), 3.17 (m, 2 H), 2.68 (t, 2 H, $J=5.7$ Hz), 2.54 (m, 2 H).

5 4-(5-FLUORO-2-METHOXY)PHENYL PIPERIDINE: mp 254-258 C; ^1H NMR δ 1.53-1.68 (m, 2H), 1.79 (d, $J=11.7$ Hz, 2H), 2.12 (dt, $J=2.1$ Hz, $J=11.7$ Hz, 1H), 2.77 (dt, $J=1.8$ Hz, $J=12.3$ Hz, 1H), 2.90-3.05 (m, 1H), 3.10-3.22 (m, 2H), 3.68 (s, 1H), 3.79 (s, 3H), 6.72-6.93 (m, 3H). Anal. Calcd. For
10 $\text{C}_{17}\text{H}_{21}\text{NOFC1} + 0.14 \text{CH}_2\text{Cl}_2$: C, 56.60; H, 6.76; N, 5.44. Found: C, 56.60; H, 6.92; N, 5.28.

TERT-BUTYL N-3-[4-(5-FLUORO-2-METHOXYPHENYL)PIPERIDINO] PROPYL-CARBAMATE: ^1H NMR δ 6.90-6.70 (m, 3 H), 5.76 (b, 1
15 H), 3.80 (s, 3 H), 3.68 (m, 1 H), 3.40-2.90 (m, 4 H), 2.45 (t, 2 H, $J=6.6$ Hz), 2.20-1.60 (m, 9 H), 1.45 (s, 9 H).

3-[4-(5-FLUORO-2-METHOXYPHENYL)PIPERIDINO]-1-PROPANAMINE: ^1H NMR δ 7.00-6.80 (m, 3 H), 3.80 (s, 3 H), 3.05 (d, 2 H, $J=11.4$ Hz), 2.76 (t, 2 H, $J=6.9$ Hz), 2.43 (dd, 2 H, $J=7.8$ Hz), 2.05 (dt, 2 H, $J=2.4, 11.7$ Hz), 1.90-1.20 (m, 10 H).
20

TERT-BUTYL 4-(1-NAPHTHYL)-1,2,3,6-TETRAHYDRO-1-PYRIDINECARBOXYL-ATE: ^1H NMR δ 8.00-7.80 (m, 2 H), 7.76 (d, 1 H, $J=8.1$ Hz), 7.50-7.44 (m, 2 H), 7.42 (d, 1 H, $J=8.1$ Hz), 7.27 (d, 1 H, $J=8.1$ Hz), 5.76 (br, 1 H), 4.14 (m, 2 H), 4 or 3.29 (t, 2 H, $J=5.7$ Hz), 2.52 (br m, 2 H), 1.53 (s, 9H).
25

30 4-(1-NAPHTHYL)PIPERIDINE: HCl salt; mp 330-332 °C; ^1H NMR δ 1.66-1.70 (m, 2H), 2.20-2.26 (m, 2H), 2.30-2.43 (m, 2H), 2.72-2.84 (m, 1H), 3.15-3.26 (m, 2H), 7.42-7.56 (m, 4H), 7.78 (d, $J=8.1$ Hz, 1H), 7.90 (d, $J=8.1$ Hz, 1H), 8.04 (d,

J=8.1 Hz, 1H). Anal. Calcd. For $C_{14}H_{17}NOCl + 0.20 CH_2Cl_2$: C, 68.96; H, 7.00; N, 5.29. Found: C, 68.64; H, 7.04; N, 5.24.

5 TERT-BUTYL N-3-[4-(1-NAPHTHYL)PIPERIDINO]PROPYLCARBAMATE:

1H NMR δ 8.09 (d, 1 H, J=8.4 Hz), 7.86 (dd, 1 H, J=1.8, 7.5 Hz), 7.71 (dd, 1 H, J=2.4, 6.9 Hz), 7.60-7.30 (m, 4 H), 6.31 (br, 1 H), 5.75 (br, 1 H), 4.26 (t, 1 H, J=5.4 Hz), 3.40-3.00 (m, 6 H), 2.54 (t, 2 H, J=6.9 Hz), 2.24 (dt, 2 H, J= 3.0, 11.4 Hz), 2.00-1.60 (m, 6 H), 1.45 (s, 9 H).

4-(3-METHYL-2-PYRIDYL)-4-PIPERIDINOL: 1H NMR δ 8.21 (dd, 1 H, J=1.2, 4.5 Hz), 7.36 (dd, 1 H, J=6.6, 7.8 Hz), 7.02 (dd, 1 H, J=4.8, 7.5 Hz), 3.07 (dt, 2 H, J=2.7, 12.3 Hz), 2.89 (m, 2 H), 2.46 (s, 3 H), 2.22 (dt, 2 H, J=4.8, 12.3 Hz), 1.39 (dm, 2 H, J=12.3 Hz).

20 TERT-BUTYL 4-(3-METHYL-2-PYRIDYL)-1,2,3,6-TETRAHYDRO-1-PYRIDINE-CARBOXYLATE: 1H NMR δ 8.16 (dd, 1 H, J=1.2, 3.3 Hz), 7.51 (dm, 1 H, J=7.5 Hz), 7.15 (dd, 1 H, J=4.8, 7.5 Hz), 5.73 (br, 1 H), 4.01 (m, 2 H), 3.59 (t, 2 H, J=5.7 Hz), 2.40 (m, 2 H), 1.44 (s, 9 H).

25 T E R T - B U T Y L
N-3-[4-(3-METHYL-2-PYRIDYL)PIPERIDINO]PROPYLCARBAMATE: 1H NMR δ 8.37 (dd, 1 H, J=4.2, 4.8 Hz), 7.51 (dd, 1 H, J=7.2, 7.5 Hz), 7.20 (dd, 1 H, J=4.5, 7.5 Hz), 6.73 (br, 1 H), 3.26 (m, 4 H), 3.05 (d, 2 H, J=12.0 Hz), 2.80-2.40 (m, 4 H), 2.61 (s, 3 H), 1.82 (p, 2 H, J=6.3 Hz), 1.54 (d, 2 H, J= 12.0 Hz).

T E R T - B U T Y L
4-(3-METHOXYPHENYL)-1,2,3,6-TETRAHYDRO-1-PYRIDINECARBOXYLATE: 1H NMR δ 7.23 (t, 1 H, J= 8.1 Hz), 6.96 (d, 1 H,

J=7.5 Hz), 6.89 (d, 1 H, J=1.8 Hz), 6.80 (dd, 1 H, J=2.4, 8.1 Hz), 6.02 (br, 1 H), 4.20-4.00 (m, 3 H), 3.80 (s, 3 H), 3.62 (t, 2 H, J=5.7 Hz), 2.51 (br, 2 H), 1.49 (s, 9 H).

5 1-BENZYL-4-METHYL-PIPERIDIN-4-OL: Methyllithium (1.4 M in Et₂O, 54.0 mL) was added to a solution of 1-benzyl-4-piperidone (5.00 mL, 27.0 mmol) in anhydrous ether at -78 °C under argon. Stirring was continued at -78 °C for 1.5 hours. Ether (200 mL) and water (40 mL) were added, and the two phases were separated. The aqueous solution was extracted with Et₂O (3 x 50 mL). The combined organic solutions were dried over magnesium sulfate and concentrated. The residue was chromatographed (EtOAc to EtOAc-MeOH 9/1), giving 4.81 g (87%) of the desired product as a colorless oil: ¹H NMR δ 1.21 (s, 3 H), 1.56 (dt, J = 13, 3 Hz, 2 H), 1.65 (td, J = 10, 4 Hz, 2 H), 2.35 (td, J = 10, 3 Hz, 2 H), 2.53 (m, 2 H), 7.24 (m, 1 H), 7.29 (m, 4 H); ¹³C NMR δ 30.44, 39.37, 50.39, 63.80, 68.50, 127.56, 128.80, 129.80, 139.17.

20

1-BENZYL-4-METHYL-4-PHENYLPYPERIDINE: 1-Benzyl-4-methyl-piperidin-4-ol (4.81 g, 23.4 mmol) was added to a suspension of AlCl₃ (15.62 g, 117 mmol) in benzene (100 mL) at room temperature under argon. The mixture was stirred at reflux for 24 hours, then cooled and poured cautiously into ice water (100 g of ice, 50 mL of water). The aqueous phase was adjusted to pH 11-12 by addition of 6 N aqueous NaOH at 0 °C, and extracted with EtOAc (3 x 100 mL). The combined organic solutions were dried over magnesium sulfate and concentrated. The residue was chromatographed (hexane- Et₂O 19/1 to 9/1, followed by hexane-EtOAc 3/1), giving the desired product (3.23 g, 52%) as a brown oil: ¹H NMR δ 1.25 (s, 3 H), 1.80 (m, 2 H), 2.17 (m, 2 H), 2.44

30

(m, 2 H), 2.55 (m, 2 H), 3.50 (s, 2 H), 7.25 (m, 1 H), 7.35 (m, 4 H); ^{13}C NMR δ 36.82, 37.65, 50.95, 54.93, 64.08, 126.19, 126.51, 127.59, 128.83, 128.95, 129.05, 129.89, 139.24.

5

4-METHYL-4-PHENYLPYPERIDINE: Freshly prepared methanolic formic acid solution (4.4% by weight, 70 mL) was added to 1-benzyl-4-methyl-4-phenylpiperidine (3.23 g, 12.2 mmol). To the resulting solution was added 10% palladium on carbon (2.00 g). The mixture was stirred at room temperature for 24 hours. The solid was filtered out and washed with MeOH (30 mL), H_2O (15 mL), CH_2Cl_2 (30 mL) and MeOH (15 mL). The combined filtrate and washings were concentrated, and the residue was dissolved in CH_2Cl_2 (50 mL) and H_2O (10 mL). The aqueous phase was adjusted to pH 11 by addition of 1 N aqueous NaOH. The organic phase was separated, dried over magnesium sulfate and concentrated. The residual oil was purified by flash chromatography ($\text{CHCl}_3/\text{MeOH}/2\text{ N NH}_3$ in MeOH 100/4/0 to 100/20/10), giving 1-benzyl-4-methyl-4-phenylpiperidine (1.20 g) and 1.10 g (51%, 82% based on consumed starting material) of 4-methyl-4-phenylpiperidine: ^1H NMR δ 1.24 (s, 3 H), 1.71 (m, 2 H), 2.06 (m, 2 H), 2.82 (m, 3 H), 2.94 (m, 2 H), 7.19 (m, 1 H), 7.32 (m, 4 H); ^{13}C NMR δ 37.22, 38.54, 43.44, 47.74, 126.31, 127.43, 129.01, 149.73.

25

3-AMINOPROPYL-4-METHYL-4-PHENYLPYPERIDINE: A solution of 4-methyl-4-phenylpiperidine (1.00 g, 5.70 mmol), 3-bromopropylamine hydrobromide (1.87 g, 8.55 mmol) and potassium carbonate (1.97 g, 14.2 mmol) in refluxing dioxane (20 mL) was stirred for 36 hours. After removal of the solvent, water (50 mL) was added and the pH adjusted to 11-12 by the addition of 1 N aqueous NaOH. The mixture was extracted

30

with CH_2Cl_2 (150 mL + 3 x 100 mL). The combined organic solutions were dried over magnesium sulfate and concentrated. The residue was purified by flash chromatography ($\text{CHCl}_3/\text{MeOH}/2\text{ N NH}_3$ in MeOH 100/20/10), giving the desired product as a colorless oil (241 mg, 18%). ^1H NMR δ 1.18 (s, 3 H), 1.61 (p, $J = 7$ Hz, 2 H), 1.75 (m, 2 H), 2.10 (m, 2 H), 2.33 (t, $J = 7$ Hz, 2 H), 2.40 (m, 2 H), 2.45 (m, 2 H), 2.72 (t, $J = 6$ Hz, 2 H), 3.02 (br s, 2 H), 7.14 (m, 1 H), 7.30 (m, 4 H); ^{13}C NMR δ 30.28, 36.78, 37.64, 41.51, 50.96, 57.51, 126.16, 126.40, 128.91, 149.20.

Preparation of

3-[4-(4-Fluorophenyl)piperidin-1-yl]propylamine

4-(4-FLUOROPHENYL)PIPERIDINE HYDROCHLORIDE: To a solution of 4-(4-fluorophenyl)-1,2,3,6-tetrahydropyridine hydrochloride (10 g) in methanol (200 mL) was added 10% palladium on charcoal (0.5 g) and the mixture was hydrogenated at 50 psi for 3 h. The catalyst was removed by filtration and solvent was evaporated, leaving the product (10.0 g) as a white powder, which was used in the next step without purification. The product appeared to be pure based on ^1H NMR and TLC analysis. ^1H NMR δ 1.95-2.03 (br d, 2H), 2.14-2.29 (m, 2H), 2.70-2.80 (m, 1H), 2.91-3.07 (br q, 2H), 3.60-3.64 (br d, 2H), 6.96-7.03 (m, 2H), 7.19-7.22 (m, 2H), 9.60 (br s, 1H), 9.71 (br s, 1H).

4-(4-FLUOROPHENYL)PIPERIDINE: mp $^{\circ}\text{C}$; ^1H NMR δ 1.51-1.66 (m, 2H), 1.80 (d, $J=7.2$ Hz, 2H), 2.53-2.64 (m, 1H), 2.67-2.77 (m, 2H), 3.17 (d, $J=12.0$ Hz, 2H), 6.94-7.03 (m, 2H), 7.13-7.21 (m, 2H).

Anal. Calcd. For $\text{C}_{11}\text{H}_{14}\text{NF} + \text{C}_4\text{H}_8\text{O}_4$: C, 58.70; H, 5.83; N, 4.18.

Found: C, 58.72; H, 5.84; N, 3.98.

3-[4-(4-FLUOROPHENYL)PIPERIDIN-1-YL]PROPYLPHTHALIMIDE: A mixture of 4-(4-fluorophenyl)piperidine hydrochloride (5.08 g, 23.2 mmol), 3-bromopropylphthalimide (6.22 g, 23.2 mmol), and potassium carbonate (15 g) in DMF (100 mL) was stirred at 95-100 C for 12 h. About 80% of the solvent was evaporated under reduced pressure. The residue was diluted with ethyl acetate (200 mL) and washed with brine (3 X 100 mL) and dried (Na_2SO_4). The solvent was evaporated from the ethyl acetate solution and the residue was purified by column chromatography (1/1 hexane-ethyl acetate to 100% ethyl acetate), giving crude product (7.50 g, 88%). This crude product was crystallized from isopropanol, giving a white crystalline solid (4.50 g, 1st crop). This material was used in the next step. Concentration of the mother liquor and cooling gave the second crop of desired product (1.0 g). ^1H NMR δ 1.43-1.52 (m, 2H), 1.67-1.75 (m, 2H), 1.80-1.96 (m, 4H), 2.33-2.46 (m, 3H), 2.94-2.99 (br d, 2H), 3.78 (t, $J=7$ Hz, 2H), 6.90-7.04 (m, 4H), 7.70-7.74 (m, 2H), 7.84-7.87 (m, 2H).

3-[4-(4-FLUOROPHENYL)PIPERIDIN-1-YL]PROPYLAMINE: Hydrazine (4 mL) was added to a solution of 3-[4-(4-fluorophenyl)piperidin-1-yl]propylphthalimide (4.50 g, 12.3 mmol) in methanol (200 mL), and the mixture was stirred at reflux for 8 h. The solution was cooled to room temperature, and the resulting white solid which formed was filtered and washed with methanol (20 mL). The solvent was evaporated from the filtrate and residue was dried under vacuum for 4 h. The crude product was dissolved in 50 mL of chloroform, stirred for 1 h, and filtered. The white solid was washed with additional chloroform (20 mL), the solvent was evaporated from the

combined filtrates to leave the crude product as an oil.
The oil was purified by column chromatography
(dichloromethane / methanol / 2 M ammonia in methanol,
10/3/1), giving the desired product (2.70 g, 93%). ¹H NMR
5 δ 1.60-1.83 (m, 6H), 1.96-2.07 (m, 4H), 2.40-2.55 (m,
3H), 2.70-2.85 (br t, 2H), 3.03-3.07 (br d, 2H),
6.93-7.00 (m, 2H), 7.14-7.20 (m, 2H).

4-(4-METHYL-4-(3,5-DIMETHYLPHENYL) PIPERIDINE:

10 hygroscopic; ¹H NMR δ 1.20 (s, 3H), 1.74-1.80 (m, 2H),
2.08-2.16 (m, 2H), 2.30 (s, 6H), 2.50-2.56 (m, 2H),
2.64-2.68 (m, 2H), 2.97-3.04 (m, 1H), 6.87 (s, 1H), 6.94
(s, 2H).

Piperidine Side Chain Intermediates

TERT-BUTYL 4-[[(TRIFLUOROMETHYL) SULFONYL] OXY]-1,2,3,6-TETRAHYDRO-1-PYRIDINECARBOXYLATE:

5 *n*-Butyl lithium (17.6 mL, 44.2 mmol, 2.5 M in hexanes) was added to a solution of diisopropyl amine (96.2 mL, 44.2 mmol) in 40 mL of dry THF at 0 °C and stirred for 20 minutes. The reaction mixture was cooled to -78 °C and *tert*-butyl 4-oxo-1-piperidinecarboxylate (Aldrich
10 Chemical Company, 40.0 mmol) in THF (40 mL) was added dropwise to the reaction mixture and stirred for 30 minutes. Tf₂NPh (42.0 mmol, 15.0 g) in THF (40 mL) was added dropwise to the reaction mixture and stirred at °C overnight. The reaction mixture was concentrated in
15 *vacuo*, re-dissolved in hexanes:EtOAc (9:1), passed through a plug of alumina and the alumina plug was washed with hexanes:EtOAc (9:1). The combined extracts were concentrated to yield 16.5 g of the desired product that was contaminated with some starting Tf₂NPh.

20 ¹H NMR (400 MHz, CDCl₃) δ 5.77 (s, 1 H), 4.05 (dm, 2 H, J=3.0 Hz), 3.63 (t, 2 H, J=5.7 Hz), 2.45 (m, 2 H), 1.47 (s, 9 H).

TERT-BUTYL 4-[3-(AMINO) PHENYL]-1,2,3,6-TETRAHYDRO-1-PYRIDINECARBOXYLATE:

25 A mixture of 2 M aqueous Na₂CO₃ solution (4.2 mL), *tert*-butyl 4-[[(trifluoromethyl) sulfonyl] oxy]-1,2,3,6-tetrahydro-1-pyridine-carboxylate (0.500 g, 1.51 mmol), 3-aminophenylboronic acid hemisulfate (0.393 g, 2.11
30 mmol), lithium chloride (0.191 g, 4.50 mmol) and tetrakis-triphenylphosphine palladium (0) (0.080 g, 0.075 mmol) in dimethoxyethane (5 mL) was heated at reflux temperature for 3 hours, under an inert

atmosphere (an initial degassing of the mixture is recommended to prevent the formation of triphenylphosphine oxide). The organic layer of the cooled reaction mixture was separated and the aqueous layer was washed with ethyl acetate (3X). The combined organic extracts were dried and concentrated *in vacuo*. The crude product was chromatographed (silica, hexanes:EtOAc:dichloromethane (6:1:1) with 1% added isopropylamine to protect the BOC group from hydrolysis) to give 0.330 g of the desired product in 81% yield:

^1H NMR (400 MHz, CDCl_3) δ 7.12 (t, 1H, $J = 7.60$ Hz), 6.78 (d, 1H, $J = 8.4$ Hz), 6.69 (t, 1H, $J = 2.0$ Hz), 6.59 (dd, 1H, $J = 2.2, 8.0$ Hz), 6.01 (m, 1H), 4.10-4.01 (d, 2H, $J = 2.40$ Hz), 3.61 (t, 2H, $J = 5.6$ Hz), 2.52-2.46 (m, 2H), 1.49 (s, 9H); ESMS m/e : 275.2 ($M + H$) $^+$.

Anal. Calc. for $\text{C}_{16}\text{H}_{24}\text{N}_2\text{O}_2$: C, 70.04; H, 8.08; N, 10.21. Found: C, 69.78; H, 7.80; N, 9.92

TERT-BUTYL 4-[3-(AMINO)PHENYL]-1-PIPERIDINECARBOXYLATE

A mixture of 3.10 g of tert-butyl 4-(3-aminophenyl)-1,2,3,6-tetrahydropyridine-1-carboxylate (11.3 mmol) and 1.0 g of 10% Pd/C in 200 mL of ethanol was hydrogenated at room temperature using the balloon method for 2 days. The reaction mixture was filtered and washed with ethanol. The combined ethanol extracts were concentrated *in vacuo* and the residue was chromatographed on silica (dichloromethane: methanol 95:5 with 1% isopropylamine added to protect the BOC group from hydrolysis) to give 2.63 g of the desired product (84%).

**TERT-BUTYL 4-(3-NITROPHENYL)-3,6-DIHYDRO-1(2H)-
PYRIDINECARBOXYLATE**

^1H NMR (400 MHz, CHCl_3) δ 8.23 (s, 1H), 8.11 (d, 1H, $J=8.0$ Hz), 7.69 (d, 1H, $J=8.0$ Hz), 7.51 (t, 1H, $J=8.0$ Hz), 6.20 (m, 1H), 4.17-4.08 (m, 2H), 3.67 (t, 2H, $J=5.6$ Hz), 2.61-2.52 (m, 2H), 1.50 (s, 9H); ESMS m/e : 249.1 ($M + H - \text{C}_4\text{H}_8$) $^+$.

1,2,3,6-TETRAHYDRO-4-(3-NITROPHENYL)PYRIDINE: Into a stirred solution of 5.00 g (16.0 mmol) of *tert*-butyl 1,2,3,6-tetrahydro-4-(3-nitrophenyl)pyridine-1-carboxylate in 100 ml of 1,4-dioxane at 0°C was bubbled HCl gas for 10 minutes. The reaction mixture was allowed to warm to room temperature and the bubbling of the HCl gas was continued for an additional 1 hour. The solvent was removed *in vacuo*, the residue was dissolved in 50 mL of water and was neutralized by the addition of KOH pellets. The aqueous solution was extracted with 3 X 80 mL of dichloromethane and the combined organic extracts were dried (MgSO_4), filtered and concentrated *in vacuo*. The residue was purified by column chromatography (silica, 9 : 1, dichloromethane : methanol + 1% isopropyl amine) to afford 2.85 g (87.5% yield) of the desired product: ^1H NMR (400 MHz, CDCl_3) δ 8.24 (s, 1H), 8.09 (d, 1H, $J=8.4$ Hz), 7.71 (d, 1H, $J=8.0$ Hz), 7.49 (t, 1H, $J=8.0$ Hz), 6.35-6.25 (m, 1H), 3.58 (apparent q, 2H, $J=3.0$ Hz), 3.14 (t, 2H, $J=5.6$ Hz), 2.54-2.46 (m, 2H).

TERT-BUTYL 3-(4-(3-NITROPHENYL)-3,6-DIHYDRO-1(2H)-PYRIDINYL)PROPYLCARBAMATE: A mixture of 2.80 g (14.0 mmol) of 1,2,3,6-tetrahydro-4-(3-nitrophenyl)pyridine,

3.60 g (15.0 mmol) of *tert*-butyl N-(3-bromopropyl)carbamate, 11.6 g (84.0 mmol) of K_2CO_3 , 14.6 mL (84.0 mmol) of diisopropylethylamine and 0.78 g (2.00 mmol) of tetrabutylammonium iodide in 250 mL of 1,4-dioxane was heated at reflux temperature for 14 hours. The reaction mixture was filtered and the filtrate was dried ($MgSO_4$), concentrated *in vacuo* and the residue was purified by column chromatography (silica, 9:1, dichloromethane: methanol + 1% isopropyl amine) to afford 4.35 g (85.7% yield) of the desired product: 1H NMR (400 MHz, $CDCl_3$) δ 8.24 (t, 1H, $J=1.9$ Hz), 8.09 (dd, 1H, $J=1.9, 8.0$ Hz), 7.70 (apparent d, 1H, $J=8.0$ Hz), 7.49 (t, 1H, $J=8.0$ Hz), 6.23 (m, 1H), 3.29-3.18 (m, 4H), 2.75 (t, 2H, $J=5.6$ Hz), 2.64-2.54 (m, 4H), 1.82-1.70 (m, 2H), 1.44 (s, 9H); ESMS m/e : 362.2 ($M + H$) $^+$.

3-(4-(3-NITROPHENYL)-3,6-DIHYDRO-1(2H)-PYRIDINYL)-1-PROPANAMINE: Into a stirred solution of 4.35 (12.0 mmol) of *tert*-butyl 3-(4-(3-nitrophenyl)-3,6-dihydro-1(2H)-pyridinyl)propylcarbamate in 100 mL of 1,4-dioxane at 0°C was bubbled HCl gas for 10 minutes. The reaction mixture was allowed to warm to room temperature and the bubbling was continued for an additional 1 hour. The solvent was removed *in vacuo*, the residue was dissolved in 50 mL of water and was neutralized by the addition of KOH pellets. The aqueous solution was extracted with 3 X 80 mL of dichloromethane, the combined organic extracts were dried ($MgSO_4$), filtered and concentrated *in vacuo*. The residue was purified by column chromatography (silica, 9 : 1, dichloromethane : methanol + 1% isopropyl amine) to afford 3.05 g (97.0% yield) of the desired product: 1H NMR (400 MHz, $CDCl_3$) δ 8.24 (t, 1H, $J=1.8$ Hz), 8.09 (dd, 1H, $J=1.8, 8.2$ Hz),

7.69 (dd, 1H, J=1.8, 8.2 Hz), 7.48 (t, 1H, J=8.2 Hz),
 6.24 (m, 1H), 3.21 (d, 2H, J=3.6 Hz), 2.84 (t, 2H, J=6.6
 Hz), 2.75 (t, 2H, J=5.8 Hz), 2.64-2.54 (m, 4H), 1.76 (m,
 2H); ESMS m/e : 262.2 (M + H)⁺; Anal. Calc. for
 5 C₁₄H₁₉N₃O₂ (0.06 CHCl₃): C, 62.90; H, 7.16; N, 15.65.
 Found: C, 63.20; H, 7.16; N, 15.65.

**METHYL (4S)-3-[(3-[4-(3-AMINOPHENYL)-1-
 PIPERIDINYL] PROPYL)AMINO) CARBONYL]-4-(3,4-
 10 DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-
 TETRAHYDRO-5-PYRIMIDINECARBOXYLATE:** A mixture of 3.02 g
 (6.33 mmol) 5-methyl 1-(4-nitrophenyl) (6S)-6-(3,4-
 difluorophenyl)-4-(methoxymethyl)-2-oxo-3,6-dihydro-
 1,5(2H)-pyrimidinedicarboxylate, 1.50 g (5.80 mmol) of
 15 3-(4-(3-nitrophenyl)-3,6-dihydro-1(2H)-pyridinyl)-1-
 propanamine, 7.94 g (75.5 mmol) of K₂CO₃ and 1.00 mL of
 methanol in 200 mL dichloromethane (under argon) was
 stirred at room temperature for 1 hour. The reaction
 mixture was filtered and concentrated *in vacuo*. The
 20 residue was dissolved in 100 mL of ethyl acetate and
 washed 3 X 50 mL of 5% aqueous NaOH solution, the
 organic layer was dried (MgSO₄) and concentrated *in*
vacuo. The residue was dissolved in 100 mL of anhydrous
 ethanol containing 0.50 g 10% Pd/C and the reaction
 25 mixture was stirred under a hydrogen balloon for 24
 hours. The reaction mixture was passed through a column
 of Celite 545 filtering agent, washed with ethanol, the
 filtrate was dried (MgSO₄) and concentrated *in vacuo*.
 The residue was purified by column chromatography
 30 (silica, 9.5 : 0.5 , dichloromethane : methanol + 1%
 isopropyl amine) to afford 1.65 g (52.0% yield) of the
 desired product.

TERT-BUTYL 4-[3-(ISOBUTYRYLAMINO) PHENYL]-3,6-DIHYDRO-**1(2H)-PYRIDINECARBOXYLATE:** Into a solution of 4.00 g

(16.0 mmol) of tert-butyl 4-(3-aminophenyl)-3,6-dihydro-

1(2H)-pyridinecarboxylate and 5.60 mL (32.0 mmol) of

diisopropylethylamine in 100 mL dichloromethane was

slowly added 1.90 mL (19.0 mmol) of isobutyryl chloride.

The reaction mixture was stirred at room temperature for 2 hours, washed with water, dried (MgSO₄), andconcentrated *in vacuo*. The residue was purified by

column chromatography (silica, 50 : 46 : 3 : 1, hexanes

: dichloromethane : methanol : isopropyl amine) to

afford 2.90 g (52.0% yield) of the desired product: ¹HNMR (400 MHz, CDCl₃) δ 7.69 (s, 1 H), 7.34 (d, 1 H, J=7.8

Hz), 7.27 (t, 1H, J=7.8 Hz), 7.11 (d, 1H, J=7.8 Hz),

6.04 (s, 1H), 4.05 (s, 2H), 3.62 (apparent t, 2 H, J=4.9

Hz), 2.51 (m, 3H), 1.49 (s, 9H), 1.25 (d, 6H, J=7.4 Hz);

ESMS *m/e*: 345.5 (M + H)⁺. Anal. Calc. forC₂₀H₂₈N₂O₃+0.175 CHCl₃: C, 66.33; H, 7.77; N, 7.67. Found:

C, 66.20; H, 7.41; N, 7.88

TERT-BUTYL 4-[3-(ISOBUTYRYLAMINO) PHENYL]-1-**PIPERIDINECARBOXYLATE:** A mixture of 2.90 g (8.40 mmol)

of tert-butyl 4-[3-(isobutyrylamino)phenyl]-3,6-dihydro-

1(2H)-pyridinecarboxylate and 0.80 g of 10% yield Pd/C

in 100 mL of ethanol was stirred under a hydrogen

balloon for 24 hours. The reaction mixture was passed

through a column of Celite 545 filtering agent, the

filtrate was dried (MgSO₄) and concentrated *in vacuo*.

The residue was purified by column chromatography

(silica, 9.5 : 0.5 ,dichloromethane : methanol + 1%

isopropyl amine) to afford 2.40 g (84.0% yield) of the

desired product: ¹H NMR (400 MHz, CDCl₃) δ 7.49-7.44 (m,

2H), 7.24 (t, 1H, J=7.6 Hz), 6.93 (d, 1H, J=7.6 Hz),

4.20-4.10 (m, 2H), 2.86-2.45 (m, 4H), 1.86-1.75 (m, 4H), 1.48 (s, 9H), 1.24 (d, 6H, $J=6.8$ Hz); ESMS m/e : 345.2 ($M + H$)⁺; Anal. Calc. for $C_{20}H_{30}N_2O_3+0.3H_2O$: C, 68.27; H, 8.77; N, 7.96. Found: C, 68.25; H, 8.54; N, 7.84.

5

2-METHYL-N-[3-(4-PIPERIDINYL) PHENYL] PROPANAMIDE: Into a stirred solution of 2.20 (6.50 mmol) of *tert*-butyl 4-[3-(isobutyrylamino)phenyl]-1-piperidinecarboxylate in 100 ml of 1,4-dioxane at 0 °C was bubbled HCl gas for 10 minutes. The reaction mixture was allowed to warm to room temperature and the bubbling of the HCl gas was continued for 1 hour. The solvent was removed *in vacuo*, the residue was dissolved in 50 mL of water and was neutralized by the addition of KOH pellets. The aqueous solution was extracted with 3 X 80 mL of dichloromethane, the combined organic extracts were dried ($MgSO_4$), filtered and concentrated *in vacuo*. The residue was purified by column chromatography (silica, 9 : 1, dichloromethane : methanol + 1% isopropyl amine) to afford 0.700 g (46.0% yield) of the desired product: 1H NMR (400 MHz, $CDCl_3$) δ 7.47 (s, 1H), 7.40 (d, 1H, $J=7.8$ Hz), 7.24 (t, 1H, $J=7.8$ Hz), 7.00 (d, 1H, $J=7.8$ Hz), 3.23-3.14 (m, 5H), 2.82-2.57 (m, 4H), 1.20 (d, 6H, $J=6.8$ Hz); ESMS m/e : 247.2 ($M + H$)⁺;

The hydrochloride salt was used for the combustion analysis: Anal. Calc. for $C_{15}H_{22}N_2O+HCl+0.15 CHCl_3$: C, 60.51; H, 7.76; N, 9.32. Found: C, 60.57; H, 7.83; N, 8.88.

30

3-(4-PIPERIDINYL) ANILINE: 1H NMR (400 MHz, $CDCl_3$) δ 7.01 (t, 1H, $J=7.6$ Hz), 6.62-6.54 (m, 3H), 3.16 (br d, 2H, $J=10.3$ Hz), 2.75 (dt, 2H, $J=2.7, 12.3$ Hz), 2.56 (tt, 1H,

J=3.6, 12.3 Hz), 1.81 (br d, 2H, J=12.3 Hz), 1.65 (dq, 2H, J=4.0, 12.3 Hz); ESMS m/e : 177.2 (M + H)⁺.

TERT-BUTYL 4-(4-NITROPHENYL)-3,6-DIHYDRO-1(2H)-

5 **PYRIDINECARBOXYLATE:** To a 25-mL RB flask, equipped with a condensor, was added *tert*-butyl 4-
{[(trifluoromethyl)sulfonyl]oxy}-3,6-dihydro-1(2H)-pyridinecarboxylate (1.0 g), 4-nitrophenylboronic acid (0.71 g), sodium carbonate (0.430 mL of 2M solution),
10 lithium chloride (0.382 g), tetrakis(triphenylphosphine)-palladium (0) (0.173 g) and ethylene glycol dimethyl ether (10 mL). The reaction mixture was flushed with Argon three times, then the reaction mixture was heated to 100 °C for 3 hrs.
15 After cooling to room temperature, the reaction mixture was diluted with methylene chloride (30 mL) and water (30 mL) and the organic layer was separated. The aqueous layer was extracted with methylene chloride (3x20 mL) and the combined organic extracts were washed
20 with sat NH₄Cl (20 mL) and brine (20 mL), dried over MgSO₄ and concentrated under reduced pressure. The residue was purified by chromatography (6:1=hexane:ethyl acetate with 1% NH₃) to afford the product (0.55 g, 59.9%) as a yellow oil. The compound is not stable at
25 room temperature and should be used as prompt as practical: ¹H NMR (400 MHz, CDCl₃) δ 8.20 (d, 2H, J=8.6 Hz), 7.51 (d, 2H, J=8.6 Hz), 6.24 (m, 1H), 4.13 (m, 2H), 3.67 (apparent t, 2H, J=5.5 Hz), 2.55 (m, 2H), 1.49 (s, 9H).

30

4-(4-NITROPHENYL)-1,2,3,6-TETRAHYDROPYRIDINE:

4-(4-Nitrophenyl)-1,2,3,6-tetrahydropyridine was prepared by a similar procedure to that used for the

preparation of 2-methyl-*N*-[3-(4-piperidinyl)phenyl]propanamide using HCl gas and *tert*-Butyl 4-(4-Nitrophenyl)-3,6-dihydro-1(2*H*)-pyridinecarboxylate (130 mg) in dioxane (5.0 mL) at room temperature. The reaction mixture was concentrated *in vacuo* to give the crude product (69.8 mg) that used in the next reaction without further purification.

10 **Dihydropyrimidine Intermediates**

3-(3,4,5-TRIFLUOROBENZYLIDENE)-2,4-PENTANEDIONE: A stirring mixture of 3,4,5-trifluorobenzaldehyde (4.20 g, 26.2 mmol), 2,4-pentanedione (2.62 g, 26.2 mmol),
 15 piperidine (0.430 g, 5.00 mmol) in benzene (150 mL) was heated at reflux temperature in a Dean-Stark apparatus for 8 h. The benzene was evaporated and the yellow oily residue was used in the next step without further purification.

20

1-[2-METHOXY-4-METHYL-6-(3,4,5-TRIFLUOROPHENYL)-1,6-DIHYDRO-5-PYRIMIDINYL]ETHANONE: A mixture 3-(3,4,5-trifluorobenzylidene)-2,4-pentanedione (26.2 mmol), *O*-methylisourea hydrogen sulfate (3.22 g, 39.3 mmol), and
 25 NaHCO₃ (6.6 g, 78.6 mmol) in EtOH (400 mL) was stirred and heated at 95-100 °C for 6 h. The mixture was filtered and the solid filter cake was washed with ethanol (100 mL). The solvent was evaporated from the combined filtrates and the crude product was purified by
 30 flash column chromatography (EtOAc/hexane, 1/9 to 1/4), to afford the desired product as an oil (2.80 g, 36%).

4-NITROPHENYL 5-ACETYL-2-METHOXY-4-METHYL-6-(3,4,5-TRIFLUOROPHENYL)-1(6H)-PYRIMIDINECARBOXYLATE:

4-Nitrophenyl chloroformate (1.89 g, 9.38 mmol) was added to a solution of 1-[2-methoxy-4-methyl-6-(3,4,5-trifluorophenyl)-1,6-dihydro-5-pyrimidinyl]ethanone (2.80 g, 9.38 mmol) and pyridine (10 mL) in CH₂Cl₂ (200 mL) at 0-5 °C, and the resulting mixture was allowed to warm to room temperature. After 12 h, the solvent was evaporated and the residue was purified by flash chromatography (dichloromethane/EtOAc, 1/9 to 3/20), to give the desired product as a white powder (4.00 g, 92%).

4-NITROPHENYL 5-ACETYL-4-METHYL-2-OXO-6-(3,4,5-TRIFLUOROPHENYL)-3,6-DIHYDRO-1(2H)-PYRIMIDINECARBOXYLATE:

A solution of 6 N aqueous HCl (4 mL) was added to a well-stirred solution of 4-nitrophenyl 5-acetyl-2-methoxy-4-methyl-6-(3,4,5-trifluorophenyl)-1(6H)-pyrimidinecarboxylate (4.00 g, 8.63 mmol) in THF (100 mL) at 0-5 °C, and the mixture was allowed to warm to room temperature. After 2 h, solvent was evaporated and the product dried under vacuum. The product was obtained as a pure single component and used in the next step without further purification (3.88 g, 100%).

: ¹H NMR (DMSO) δ 10.29 (s, 1H), 8.23 (d, 2H, J=9.1 Hz), 7.51 (d, 2H, J=9.1 Hz), 7.15-7.07 (m, 2H), 6.18 (s, 1H), 2.30 (s, 3H), 2.28 (s, 3H); ESMS m/e: 450.2 (M + H)⁺; Anal. Calc. for C₂₀H₁₄F₃N₃O₆: C, 53.46; H, 3.14; N, 9.35. Found: C, 53.26; H, 3.21; N, 9.35.

BENZYL 2-PROPIONYL-3-(3,4,5-TRIFLUOROPHENYL)-2-

PROPENOATE. A solution of benzyl propionylacetate (36.3 g, 176 mmol), 3,4-difluorobenzaldehyde (25.0 g, 176 mmol), piperidine (0.86 mL, 9.0 mmol) and acetic acid (0.49 mL, 9.0 mmol) were heated at reflux temperature with removal of water using a Dean-Stark apparatus for 5h. The solvent was removed *in vacuo* and the residue was dissolved in EtOAc. The organic layer was washed with water (100 mL) followed by brine (100 mL) and dried over anhydrous Na₂SO₄. The solvent was evaporated to afford a pale yellow syrup (60.2 g), which was used in the next step without further purification.

BENZYL 6-(3,4-DIFLUOROPHENYL)-4-ETHYL-2-METHOXY-1,6-

DIHYDRO-5-PYRIMIDINECARBOXYLATE. A suspension of benzyl 2-propionyl-3-(3,4,5-trifluorophenyl)-2-propenoate (16.0 g, 48.0 mmol), O-methylisourea hydrogen sulfate (16.65 g, 97.02 mmol), NaHCO₃ (16.3 g, 130.2 mmol) in DMF (190 mL) was stirred at 70 °C for 20h. After cooling to room temperature, the reaction mixture was filtered and the filtrate was diluted with EtOAc (300 mL) and then washed with water (4X100 mL), brine (200 mL) and dried over Na₂SO₄. After removal of solvent, the residue was purified by column chromatography (SiO₂, EtOAc/Hexane, 10%-30%) to afford benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,6-dihydro-5-pyrimidinecarboxylate as a colorless oil (10.6 g, 58% yield). The product was directly used in the next step after ¹H NMR spectroscopy which showed it to be a mixture of amine/imine tautomers.

5-BENZYL 1-(4-NITROPHENYL) 6-(3,4-DIFLUOROPHENYL)-4-ETHYL-2-METHOXY-1,5(6H)-PYRIMIDINEDICARBOXYLATE.

Into a well-stirred solution of benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,6-dihydro-5-pyrimidinecarboxylate (27.5 g, 68.75 mmol) and pyridine (9.2 mL) in CH₂Cl₂ (300 mL) was added 4-nitrophenyl
 5 chloroformate (14.49 g, 82.5 mmol) at room temperature. The reaction mixture was stirred for 4 h and then washed with 10% aqueous KOH solution (2 X 150 mL). The organic layer was separated and dried over Na₂SO₄. The solvent was removed *in vacuo* and the residue was used in the
 10 next step without further purification: ¹H NMR (CDCl₃) δ 1.24 (t, J=7.2 Hz, 3H), 2.81-2.98 (m, 3H), 3.97 (s, 3H), 5.14 (AB_q, 2H), 6.28 (s, 3H), 7.03-7.29 (m, 8H), 7.35 (d, J=9.2 Hz, 2H), 8.26 (d, J=9.2 Hz, 2H).

15 **BENZYL 6-(3,4-DIFLUOROPHENYL)-4-ETHYL-2-METHOXY-1-
 ({[(1R)-1-PHENYLETHYL]AMINO}CARBONYL)-1,6-DIHYDRO-5-PYRIMIDINECARBOXYLATE.**

Into a stirred mixture of 5-benzyl 1-(4-nitrophenyl) 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,5(6H)-
 20 pyrimidinedicarboxylate (12.6 g, 22.86 mmol) in THF (150 mL) was added a solution of R-(+)-α-methyl benzylamine (3.53 mL, 27.44 mmol) at room temperature. The stirring was continued for 12 h and the solvent was removed *in vacuo*. The yellow residue was dissolved in chloroform
 25 (200 mL) and was washed with 10% K₂CO₃ solution (2 x 30 mL). The organic layer was dried over Na₂SO₄, filtered and the solvent was removed *in vacuo*. The resulting mixture of diastereomers was separated by column
 chromatography over silica gel with 9:1 pet. ether:ether
 30 to 4:1 pet. ether:ether. First major product to elute was (+)-benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1-({[(1R)-1-phenylethyl]amino}carbonyl)-1,6-dihydro-5-pyrimidinecarboxylate: Colorless oil, R_f= 0.31(4:1 pet

ether:ether); wt.= 3.8 g (60% yield); $[\alpha]_D = +267.05$ (c = 0.76, CHCl₃); ¹H NMR (CDCl₃) δ 1.22 (t, J=7.5 Hz, 3H), 1.52 (d, J=6.9 Hz, 3H), 2.88 (q, J=6.0 Hz, 2H), 3.99 (s, 3H), 4.99 (m, 1H), 5.09 (AB_q, 2H), 6.66 (s, 1H), 6.99-7.36 (m, 13H); The second major product to elute was (-)-benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1-(((1R)-1-phenylethylamino)carbonyl)-1,6-dihydro-5-pyrimidinecarboxylate: Colorless oil; R_f= 0.22 (4:1 pet ether:ether); wt.= 3.2 g (51.2% yield); $[\alpha]_D = -146.89$ (c = 0.38, CHCl₃); ¹H NMR (CDCl₃) δ 1.22 (t, J=7.2 Hz, 3H), 1.49 (d, J=6.6 Hz, 3H), 2.88 (q, J=6.0 Hz, 2H), 3.94 (s, 3H), 5.03 (m, 1H), 5.11 (AB_q, 2H), 6.68 (s, 1H), 6.91-7.34 (m, 13H).

(+)-BENZYL 6-(3,4-DIFLUOROPHENYL)-4-ETHYL-2-METHOXY-1,6-DIHYDRO-5-PYRIMIDINECARBOXYLATE. Into a stirred solution of (+)-benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1-(((1R)-1-phenylethylamino)carbonyl)-1,6-dihydro-5-pyrimidinecarboxylate (17.1 mmol, 9.35 g) in CH₂Cl₂ was added 1,8-diazabicyclo[5,4,0]-undec-7-ene (17.1 mmol, 2.56 mL) and stirring was continued for 16 h at room temperature. The solvent was evaporated and the residue was purified by flash column chromatography on silica gel with 3:1 EtOAc/Hexanes as the eluting system. 5.27 g of the (+)-benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,6-dihydro-5-pyrimidinecarboxylate was obtained (77% yield).

(+)-5-BENZYL 1-(4-NITROPHENYL) 6-(3,4-DIFLUOROPHENYL)-4-ETHYL-2-METHOXY-1,5(6H)-PYRIMIDINEDICARBOXYLATE. Into a well-stirred solution of (+)-benzyl 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,6-dihydro-5-

pyrimidinecarboxylate (6.4 g, 16.0 mmol) and pyridine (1.5 mL) in CH₂Cl₂ (150 mL) was added 4-nitrophenyl chloroformate (3.41 g, 19.2 mmol) at room temperature. The reaction mixture was stirred for 4 h and then it was
5 washed with 10% aqueous KOH solution (2 X 100 mL). The organic layer was separated and dried over Na₂SO₄. The solvent was removed *in vacuo*. The residue of (+)-5-benzyl 1-(4-nitrophenyl) 6-(3,4-difluorophenyl)-4-ethyl-2-methoxy-1,5(6*H*)-pyrimidinedicarboxylate was used in
10 the next step without further purification.

a. 2-(4-METHOXYBENZYL)-2-THIOPSEUDOUREA HYDROCHLORIDE.

Into a well-stirred suspension of thiourea (7.6 g, 0.1 mol) in THF (50 mL) at 0 °C, 4-methoxybenzyl chloride (16
15 g, 0.1 mol) was added in 10 min and the reaction mixture was allowed to warm to room temperature. After 2 hours the reaction mixture was heated to 65 °C and kept at that temperature for 5 hours. The reaction mixture was cooled to room temperature and diluted with diethyl
20 ether (200 mL). The white precipitate that formed was filtered and dried (22.5 g, 96% yield); m. p. 161-163 °C.

b. METHYL 2-((4-NITROPHENYL)METHYLENE)-3-OXOBUTYRATE.

A mixture of 4-nitrobenzaldehyde (15.1 g, 0.1 mol),
25 methyl acetoacetate (12.773 g, 0.11 mol), piperidine (0.41 g, 4.80 mmol), and acetic acid (0.288 g, 4.8 mmol) in 2-propanol (400 mL) was stirred at room temperature for 48 hours. The resulting white solid, methyl 2-((4-nitrophenyl)methylene)-3-oxobutyrates was filtered,
30 washed with 2-propanol (2 X 50 mL) and dried (21.8 g, 93% yield).

c.

1,6-DIHYDRO-5-METHOXYCARBONYL-2-[(4-METHOXYPHENYL)METHYL]THIO]-4-METHYL-6-(4-NITROPHENYL)PYRIMIDINE.

A mixture of methyl 2-[(4-nitrophenyl)methylene]-3-oxobutyr-
 5 oxobutyr-ate (8.96 g, 0.04 mol), 2-(4-methoxybenzyl)-2-thiopseudourea hydrochloride (9.28 g, 0.04 mol), and NaOAc (3.28 g, 0.04 mol) in DMF (100 mL) was stirred and heated at 70-75 °C for 4.5 hours. The reaction mixture was cooled to room temperature, poured into ice-water
 10 (300 mL) and extracted with EtOAc (2 X 400 mL). The combined EtOAc extracts were washed with 10% NaHCO₃ solution (2 X 60 mL), brine (100 mL), and then dried (MgSO₄). The solvent was evaporated and the crude product was purified by flash column chromatography on
 15 silica gel using 10% through 30% EtOAc in hexane as the gradient eluent. The desired product was obtained as an oil, which on trituration with EtOAc/hexane became a yellow solid (11.4 g, 66.7% yield) which was shown by ¹H NMR to be a mixture of tautomers: m.p. 138-139 °C; ¹H NMR
 20 (CDCl₃) δ 2.15 (s, 3 H), 3.62 (s, 3 H), 3.72 (s, 3 H), 4.05 and 5.78 (s and d, J=3 Hz, 1 H), 4.08, 4.20 (AB q, J=12.5 Hz, 2 H), 4.21 and 6.40 (s and d, J=3 Hz, 1 H), 6.66 (2 d, J=8.5 Hz, 2 H), 7.08 (2 d, J=8.5 Hz, 2 H), 7.37 (2 d, J=8.8 Hz, 2 H), 8.7 (2 d, J=8.8 Hz, 2 H);
 25 Anal. Calcd. for C₂₁H₂₁N₃O₅S: C, 59.00; H, 4.95; N, 9.83. Found: C, 59.02; H, 4.93; N, 9.77.

d. 1,6-DIHYDRO-5-METHOXYCARBONYL-2-[(4-METHOXYPHENYL)METHYL]THIO]-4-METHYL-6-(4-NITROPHENYL)-1-[(4-NITROPHENYL)OXY]CARBONYL]PYRIMIDINE.

30 Into a well-stirred mixture of 1,6-dihydro-5-methoxy carbonyl-2-[(4-methoxyphenyl)methyl]thio]-4-methyl-6-(4-nitrophenyl)pyrimidine (4.50 g, 10.5 mmol), NaHCO₃ (3.69

g, 0.044 mol), CH_2Cl_2 (200 mL), and water (50 mL) at 0-5 °C, 4-nitrophenyl chloroformate (2.40 g, 12.0 mmol) was added over a 5 min period and the reaction mixture was allowed to warm to room temperature. After 10 hours, the TLC analysis of the reaction mixture showed the presence of a small amount of starting pyrimidine, therefore, more 4-nitrophenyl chloroformate (0.65 g, 0.0032 mol) was added and the stirring was continued for an additional 4 hours. The two layers were separated, the CH_2Cl_2 layer was washed with saturated aqueous NaHCO_3 solution (3 X 50 mL), dried (MgSO_4), and the solvent evaporated. The residue was recrystallized from CH_2Cl_2 and hexane to give the product as white crystals (5.50 g, 88.4% yield): m.p. 156-157 °C; $^1\text{H-NMR}$ (CDCl_3) δ 2.53 (s, 3 H), 3.70 (s, 3 H), 3.81 (s, 3 H), 4.06, 4.36 (ABq, $J=13.5$ Hz, 2 H), 6.30 (s, 1 H), 6.78 (d, $J=8.6$ Hz, 2 H), 7.17 (d, $J=8.6$ Hz, 2 H), 7.20 (d, $J=8.8$ Hz, 2 H), 7.32 (d, $J=8.8$ Hz, 2 H), 7.97 (d, $J=8.8$ Hz, 2 H), 8.25 (d, $J=8.8$ Hz, 2 H); Anal. Calcd. for $\text{C}_{28}\text{H}_{24}\text{N}_4\text{O}_9\text{S}$: C, 56.75; H, 4.08; N, 9.45. Found: C, 56.49; H, 4.28; N, 9.25.

a. 6-(BENZOFURAZAN-5-YL)-1,6-DIHYDRO-2-OXO-5-METHOXYCARBONYL-4-BROMOMETHYL-1-[(4-NITROPHENYL-OXY) CARBONYL] PYRIMIDINE.

Into a well-stirred solution of 6-(benzofurazan-5-yl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-[(4-nitrophenyl-oxy)carbonyl]pyrimidine (0.310 mmol, 0.140 g) in 1.5 mL of chloroform was added a solution of bromine (0.310 mmol, 0.020 mL) in 1.5 mL of chloroform at 0 °C and the solution was allowed to attain room temperature over 1.5 h. The solvent was removed *in vacuo* and the residue was again dissolved in CHCl_3 (10 mL) and washed with brine. The organic layer was

separated, dried over Na_2SO_4 , filtered and the solvent was removed *in vacuo* to obtain 0.15 g (88% yield) of 6-(benzofurazan-5-yl)-1,6-dihydro-2-oxo-5-methoxycarbonyl-4-bromomethyl-1-[(4-nitrophenyl-oxy)carbonyl]pyrimidine as a yellow foam. The crude product was used in the next step without purification. ^1H NMR (CDCl_3) δ 3.79 (s, 3 H), 4.72 (ABq, 2 H), 6.47 (s, 1 H), 7.37 (d, $J=9.1$ Hz, 2 H), 7.51 (d, $J=7.8$ Hz, 1 H), 7.80 (s, 1 H), 7.92 (d, $J=9.1$ Hz, 1 H), 8.30 (d, $J=9.1$ Hz, 2 H).

c. 4-NITROPHENYL 4-(2,1,3-BENZOXADIAZOL-5-YL)-2,5-DIOXO-1,2,5,7-TETRAHYDROFURO[3,4-D]PYRIMIDINE-3(4H)-CARBOXYLATE.

6-(3,4-Benzofurazan-5-yl)-1,6-dihydro-2-oxo-5-methoxycarbonyl-4-bromomethyl-1-[(4-nitrophenyloxy)carbonyl]pyrimidine (0.27 mmol, 0.15 g) was heated in oil bath for 3 h (bath temperature 130°C). The brownish-yellow residue thus obtained was washed with CHCl_3 and 4-nitrophenyl 4-(2,1,3-benzoxadiazol-5-yl)-2,5-dioxo-1,2,5,7-tetrahydrofuro[3,4-d]pyrimidine-3(4H)-carboxylate was obtained as an off-white solid which was used in the next step without further purification (crude wt. 0.11 g, 93% yield): ^1H NMR ($\text{DMSO}-d_6$) δ 8.38-7.56 (m, 7H), 6.33 (s, 1H), 5.02 (s, 2H); Anal. Calc. for $\text{C}_{19}\text{H}_{11}\text{N}_5\text{O}_8+2.3\text{H}_2\text{O}$: C, 47.85; H, 3.28; N, 14.63. Found: C, 47.73; H, 2.51; N, 14.77.

5-METHYL 1-(4-NITROPHENYL) 4-(BROMOMETHYL)-6-(3,4-DIFLUOROPHENYL)-2-OXO-3,6-DIHYDRO-1,5(2H)-

PYRIMIDINEDICARBOXYLATE: Into a well-stirred solution of 6-(3,4-Difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-[(4-

nitrophenyloxy)carbonyl]pyrimidine (1.5 mmol, 0.66 g) in 5 mL of chloroform was added a solution of bromine (1.5 mmol, 0.09 mL) in 3 mL of chloroform at 0 °C and the solution was allowed to attain room temperature over 1.5 h. The solvent was removed *in vacuo* and the residue was again dissolved in CHCl₃ (20 mL) and washed with brine. The organic layer was separated, dried over Na₂SO₄, filtered and the solvent was removed *in vacuo* to afford the desired product as a yellow foam, which was used in the next step without purification. ¹H NMR δ 3.75 (s, 3 H), 4.67 (ABq, 2 H), 6.35 (s, 1 H), 7.09-7.19 (m, 4 H), 7.37 (d, J=9.0 Hz, 2 H), 8.27 (d, J=9.0 Hz, 2 H).

4-NITROPHENYL 4-(3,4-DIFLUOROPHENYL)-2,5-DIOXO-1,2,5,7-TETRAHYDROFURO[3,4-D]PYRIMIDINE-3(4H)-CARBOXYLATE.
5-methyl 1-(4-nitrophenyl) 4-(bromomethyl)-6-(3,4-difluorophenyl)-2-oxo-3,6-dihydro-1,5(2H)-pyrimidinedicarboxylate (1.5 mmol, 0.81 g) was heated in an oil bath for 3 h (bath temperature 130 °C). The brown residue thus obtained was washed with CHCl₃ and the desired product was obtained as a pale brown solid which was used in the next step without further purification (crude wt. 0.51 g): ¹H NMR (DMSO-d₆) δ 4.94 (br s, 2 H), 6.08 (s, 1 H), 7.20-7.43 (m, 4 H), 8.35 (d, J=10.2 Hz, 2 H).

4-NITROPHENYL 4-(1,3-BENZODIOXOL-5-YL)-2,5-DIOXOHXAHYDROFURO[3,4-D]PYRIMIDINE-3(4H)-CARBOXYLATE: ¹H NMR (DMSO) δ 11.35 (s, 1H), 8.16 (d, 2H, J=9.5 Hz), 7.32 (d, 2H, J=8.9 Hz), 6.81-6.65 (m, 3H), 5.88 (s, 1H), 4.85 (ABq, 2H); ESMS m/e : 440.1 (M + H)⁺; Anal. Calc. for C₂₀H₁₅N₃O₉+1.5H₂O: C, 51.29; H, 3.87; N, 8.97. Found: C, 51.38; H, 2.85; N, 8.73.

5-METHYL 1-(4-NITROPHENYL) (6S)-6-(3,4-DIFLUOROPHENYL) -
4-METHYL-2-OXO-3,6-DIHYDRO-1,5(2H) -

PYRIMIDINEDICARBOXYLATE: ^1H NMR (400 MHz, CDCl_3) δ 8.29

5 (d, 2H, $J=9.1$ Hz), 7.36 (d, 2H, $J=8.9$ Hz), 7.25-7.11 (m, 3H), 6.37 (s, 1H), 3.75 (s, 3H), 2.46 (s, 3H); ESMS m/e : 448.1 ($M + H$) $^+$; Anal. Calc. for $\text{C}_{20}\text{H}_{15}\text{F}_2\text{N}_3\text{O}_7$: C, 53.70; H, 3.38; N, 9.39. Found: C, 53.35; H, 3.36; N, 9.27.

BENZYL

4-{[(TERT-BUTOXYCARBONYL)AMINO]METHYL}CYCLOHEXYLCARBAMATE
: Oxalyl chloride (1.1 equivalents) was added dropwise to
5 a mixture of 4-[(tert-butoxycarbonyl)-amino]methyl]-
cyclohexanecarboxylic acid (1 equivalent, Maybridge) in
toluene. The reaction mixture was stirred at room
temperature for 2-6 h. The solvent was removed *in vacuo*,
the residue was dissolved in acetone and the resulting
10 mixture was added dropwise to an aqueous solution of
sodium azide (1.2 equivalents) at a rate such as to
maintain a temperature of 10-15 °C. After the completion
of the reaction, the reaction mixture was extracted with
ethyl acetate, the combined extracts were dried and
15 concentrated *in vacuo*. The residue was dissolved in
acetone and added slowly to warm (60 °C) benzene. After
the completion of the reaction, benzyl alcohol was added
to the reaction mixture, stirred for 2 days and the
desired product was isolated (For Typical References,
20 See: G. Schroeter Ber. 1909, 42, 3356; and Allen, C.F.H.;
Bell, A. *Org. Syn. Coll. Vol. 3* (1955) 846.).

A solution of benzyl 4-[(tert-butoxycarbonyl)amino]
methyl}-cyclohexyl carbamate in MeOH containing 10% Pd/C
25 was hydrogenated at 50 psi overnight. The reaction
mixture was filtered through Celite 545 and the Celite
545 was washed with methanol. The combined methanol
extracts were concentrated *in vacuo*, giving *trans*-
tert-butyl 4-aminocyclohexylmethylcarbamate (95 %).

30 9H-9-FLUORENYLMETHYL N-[4-(AMINOMETHYL)CYCLOHEXYL]
CARBAMATE: : ¹H NMR δ 8.02 (br, 1 H), 7.33 (m, 5 H), 5.07
(s, 2 H), 3.71 (s, 1 H), 3.40 (br m, 1 H), 2.80 (br m, 2
H), 1.94 (ABq, 4 H), 1.68 (br, 1 H), 1.30-1.00 (m, 5 H).

35

N1-[4-(AMINOMETHYL)CYCLOHEXYL]-1-NAPHTHAMIDE: HCl in dioxane (10 mL, 4 N) was added to a solution of *tert*-butyl[4-(1-naphthoyl-amino)cyclohexyl]methylcarbamate (0.350 g) in dichloromethane (20 mL), stirred overnight, concentrated *in vacuo*, giving the desired product: ^1H NMR δ 8.24 (dd, 1 H, $J=1.2, 8.7$ Hz), 7.85 (dt, 2 H, $J=2.7, 9.7$ Hz), 7.60-7.30 (m, 4 H), 5.98 (m, 1 H), 4.02 (m, 1 H), 3.80-3.40 (m, 4 H), 2.53 (d, 2 H, $J=6.0$ Hz), 2.02 (ABq, 4 H), 1.41-1.90 (m, 4 H).

TERT-BUTYL N-(4-[(1-NAPHTHYLCARBONYL)AMINO]-CYCLOHEXYLMETHYL)-CARBAMATE: A mixture of 1-naphthoic acid (1.00 mmol, 0.172 g), DMAP (2.00 mmol, 0.250 g) and ECD (0.383 g, 2.00 mmol) in dry dichloromethane (20 mL) was stirred at room temperature for 0.5 h followed by the addition of *tert*-butyl(4-amino)cyclohexyl)methylcarbamate amine (1.09 mmol, 0.250 g). The reaction mixture was stirred at room temperature overnight and purified by flash chromatography, giving the desired product as a white solid (0.160 g): ^1H NMR δ 8.29 (dd, 1 H, $J=1.8, 9.1$ Hz), 7.89 (m, 2 H), 7.60-7.40 (m, 4 H), 5.85 (br d, 1 H, $J=6.3$ Hz), 4.65 (m, 1 H), 4.04 (m, 1 H), 3.02 (t, 1 H, $J=6.3$ Hz), 2.05 (ABq, 4 H), 1.62 (m, 2 H), 1.46 (s, 9 H), 1.40-1.10 (m, 4 H).

4-ACETYL-1-(3-AMINOPROPYL)-4-PHENYLPYPERIDINE: A solution of 4-Acetyl-4-phenylpyperidine (7, 1.53 g, 7.50 mmol), 3-bromo-propylamine hydrobromide (1.64 g, 7.50 mmol) and potassium carbonate (1.24 g, 9.00 mmol) was stirred in refluxing 1,4-dioxane (50 mL) for 12 h. After removal of dioxane, water (50 mL) was added and the pH was adjusted to 11-12 by addition of 1 N aqueous NaOH. The mixture was extracted with CH_2Cl_2 (100 mL + 3 x 50 mL). The combined organic solutions were dried over magnesium

sulfate and concentrated. The residue was purified by flash chromatography (EtOAc-MeOH-Et₃N 100/40/20), giving the desired product as a colorless oil (780 mg, 40%): ¹H NMR δ 1.56 (p, J = 7 Hz, 2 H), 1.84 (s, 3 H), 1.98 (m, 2 H), 2.15 (br t, J = 12 Hz, 2 H), 2.29 (t, J = 7 Hz, 2 H), 2.41 (br d, J = 12 Hz, 2 H), 2.66 (t, J = 7 Hz, 4 H), 7.18 - 7.30 (m, 5 H); ¹³C NMR δ 26.28, 31.11, 33.43, 41.47, 51.62, 55.31, 57.19, 77.32, 77.74, 78.17, 126.95, 127.69, 129.44, 142.25, 210.15.

For the preparation of benzo-4',5'[H]furanpiperidine refer to W.E.Parham et al, *J. Org. Chem.* (1976) 41, 2268.

TERT-BUTOXY{[3-(BENZO-4',5'[H]FURANPIPERIDIN-1-YL)PROPYL]AMINO}METHANOL: To a stirred solution of the N-[4-(benzo-4',5'[H]furanpiperidine (0.566 g, 3.27 mmol) in dioxane (20 mL), N-(tert-butoxycarbonyl)-3-bromopropylamine (0.772 g, 3.27 mmol) and potassium carbonate (0.904 g, 6.54 mmol) were added and the solution was refluxed for 24 h. The reaction mixture was cooled to room temperature, concentrated and partitioned between chloroform (40 mL) and water (5 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by column chromatography (ethyl acetate/ methanol, 4.5/0.5), giving the desired product as a colorless oil (0.856 g, 79 %); ¹H NMR (1.45 (s, 9 H), 1.63-2.04 (m, 6 H), 2.33-2.52 (m, 4 H), 2.87 (d, J=11.0 Hz, 2 H), 3.2 (br s, 2 H), 5.07 (s, 2 H), 5.6 (br s, 1 H), 7.13-7.28 (m, 4 H).

3-(4-METHYL-4-PHENYL-1-PIPERDINYL)PROPYLAMINE:

Trifluoroacetic acid (1 mL) was added to tert-butoxy{[3-(4-methyl-4-phenyl-1-piperdiny)propyl]-amino}methanol (0.500 g, 1.51 mmol) in dichloromethane (5 mL) and the

solution was stirred at room temperature for 1 h. The solution was concentrated, neutralized with 10 % KOH solution and extracted with dichloromethane (25 mL). The organic layer was dried over sodium sulfate, filtered and concentrated, giving 0.340 g (98%) of 3-(4-methyl-4-phenyl-1-piperdiny)propylamine which was used without further purification in the subsequent step.

Procedures for the Reaction of the Amine Side Chains with the p-Nitrophenylcarbamate Intermediates:

General Procedure:

An equimolar solution of an amine side chain such as 3-(4-methyl-4-phenyl-1-piperdiny)propylamine and a p-nitrophenylcarbamate intermediate such as 5-methoxycarbonyl-4-methoxymethyl- 1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-1-[(4-nitrophenyloxy)carbonyl]pyrimidine and 1-2 equivalents of a base such as diisopropylethylamine in dichloromethane were stirred at room temperature overnight. The reaction mixture was concentrated and purified by flash chromatography, giving the desired product. In case of 2-methoxy intermediates, conversion to the oxo derivatives was accomplished by treatment of the 2-methoxy product with HCl in dioxane.

2-OXO-3-{SPIRO[1H-INDANE-1,4'-PIPERIDINE]PROPYLAMINE (0.0319 g, 0.123 mmol) was added to (\pm)-6-(3,4-difluorophenyl)-1,6-dihydro- 2-methoxy-5-methoxycarbonyl-4-ethyl-1-(4-nitrophenoxy)carbonylpyrimidine (0.052 g, 0.112 mmol) in dry dichloromethane (10 mL) and the solution was stirred at room temperature for 24 h. The reaction mixture was stirred for another 1 h after addition of 6 N HCl (2 mL). After neutralization with aqueous 10% KOH solution, the reaction mixture was

extracted into dichloromethane (3 x 10 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving of the
5 desired product (0.040 g) as a syrup.

1 N HCl in ether (5 mL) was added to the free base (0.040 g, 0.072 mmol) in dichloromethane (4 mL) and the solution was concentrated under reduced pressure. The crude
10 product was recrystallized from ether, giving the desired compound (0.042 g, 99 %) as a pale yellow solid; mp 178-182 °C; Anal. Calcd. for $C_{12}H_{14}F_2N_4O_5Cl_2 + 0.6 H_2O$: C, 57.87; H, 5.73, N 9.31. Found: C, 58.11; H 5.90; N 8.95.

15 General Procedure for the reaction of the piperidines and piperazines with 1-(3-bromo-propylcarbamoyl)-6-(3,4-difluoro-phenyl)-4-methyl-2-oxo-1,6-dihydro-pyrimidine-5-carboxylic acid methyl ester:

20 The amine (0.15 mmol) was added to a solution of 1-(3-bromo- propylcarbamoyl)-6-(3,4-difluorophenyl)-4-methyl-2-oxo-1,6-di-hydropyrimidine-5-carboxylic acid methyl ester (43.0 mg, 0.100 mmol) in anhydrous acetone (10 mL), followed by NaHCO₃ (41 mg, 0.3 mmol) and KI (16
25 mg, 0.1 mmol). The resulting suspension was heated to reflux for 10 h and then cooled to room temperature. The solvent was removed *in vacuo* and the residue was purified by flash column chromatography (EtOAc, followed by EtOAc/MeOH, 9/1). The product was then dissolved in 2 mL
30 of chloroform, acetone or EtOAc and HCl in Et₂O (1 M, 0.5 mL) was added at room temperature. The solvent was removed *in vacuo*, giving the desired compound as an HCl salt.

Example 1

(-)-1,2,3,6-TETRAHYDRO-1-{N-[4-(3,-ACETAMIDO)-PHENYL-
PIPERIDIN-1- YL]PROPYL}CARBOXAMIDO-4-METHOXYMETHYL-6-
(3,4- DIFLUORO-PHENYL)-2- OXOPYRIMIDINE-5-CARBOXYLIC ACID
5 METHYL ESTER: ESMS, 612.25 (M+1); ¹H NMR δ 1.76-1.87 (m,
6H), 2.03-2.13 (m, 2H), 2.18 (s, 3H), 2.49 (t, J=6.9 Hz,
3H), 3.10 (d, J=11.1 Hz, 2H), 3.30-3.42 (m, 2H), 3.45 (s,
3H), 3.71 (s, 3H), 4.68 (s, 2H), 6.68 (s, 1H), 6.96 (d,
J=7.5 Hz, 1H), 7.04-7.11 (m, 2H), 7.16-7.26 (m, 2H), 7.34
10 (d, J=6.3 Hz, 1H), 7.45 (s, 1H), 7.94 (s, 1H), 8.98 (t,
J=5.4 Hz, 1H).

Example 2

15 METHYL 3-[(3-4-[3-(ACETYLAMINO)PHENYL]-1,2,3,6-
TETRAHYDRO-1-PYR-IDINYLPROPYL)AMINO]CARBONYL-4-(3,4-
DIFLUOROPHENYL)-6-(METHOXY-METHYL)-2-OXO-1,2,3,4-
TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: ¹H NMR δ 8.90 (t, 1 H,
J=3.6 Hz), 7.75 (s, 1 H); 7.50-7.00 (m, 8 H), 6.68 (s, 1
20 H), 6.03 (br s, 1 H), 4.67 (s, 2 H), 3.71 (s, 3 H), 3.47
(s, 3 H), 3.38 (ABm, 2 H), 3.16 (m, 2 H), 2.71 (t, 2 H, J
=5.4 Hz), 2.56 (m, 4 H), 2.35-1.90 (br, 2 H), 2.17 (s, 3
H), 1.82 (p, 2 H, J=7.2 Hz); ESMS, 612.25 (M+1).

Example 3

25 (1)-1,2,3,6-TETRAHYDRO-1-{N-[3-(4-O-ACETYL)-4-PHENYLPIPER
IDIN-1- YL]PROPYL}CARBOXAMIDO-5-METHOXYCARBONYL-
4-METHOXYMETHYL-6-(3,4- DIFLUOROPHENYL)-2-OXOPYRIMIDINE:
4-Acetyl-1-(3-aminopropyl)- 4-phenylpiperidine (190 mg,
30 0.687 mmol) was added to a stirring solution of 5-methoxy
carbonyl-4-methoxymethyl- 1,2,3,6-tetra-hydro-2-oxo-
6-(3,4-difluorophenyl)-1-[(4-nitrophenyloxy)carbon-
yl]pyrimidine (281 mg, 0.573 mmol) in dry
dichloromethane (3 mL) and THF (4 mL). The reaction

mixture was stirred at room temperature for 12 h. The reaction mixture was quenched with aqueous 6 N HCl. The reaction mixture was concentrated to a small volume, partitioned between dichloromethane and water (100 mL each), the mixture was adjusted to pH 8 by addition of Na CO₃, the layers were separated, and the aqueous layer was extracted with dichloromethane (3 x 30 mL). The combined organic extracts were dried (Na₂SO₄) and the product was chromatographed, giving the desired product. The HCl salt was prepared by the addition of 1 N HCl in ether to a solution of the product in CH₂Cl₂. The precipitated salt was filtered, washed with ether and dried *in vacuo*, giving (1)-1,2,3,6-tetrahydro-1-{N-[3-(4-O-acetyl)-4- phenylpiperidin-1-yl]propyl} carboxamido-5-methoxycarbonyl-4- methoxymethyl-6-(3,4-difluorophenyl)-2-oxopyrimidine (170 mg, 47%) as the hydrochloride salt: (C₃₁H₃₆N₄F₂O₄ + HCl + 0.6 CH₂Cl₂); mp 82-84 °C.

Example 4

Benzyl ester precursor to the product of Example 4:
(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(BENZO-4',5' (H) FURAN) PIPERIDIN-1- YL] PROPYL}-CARBOXAMIDO-4-ETHYL-6-(3,4-DIFLUOROPHENYL)-2-OXO- PYRIMIDINE-5- CARBOXYLIC ACID
PHENYLMETHYL ESTER: ¹H NMR δ 7.60-7.00 (m, 12 H), 6.85 (br, 1 H), 6.62 (s, 1 H), 5.10 (ABq, 2 H), 5.67 (s, 2 H), 4.03 (br, 1 H), 4.01 (s, 3 H), 3.40 (apparent q, 2 H, J=6.8 Hz), 3.20-1.60 (m, 12 H), 2.86 (q, 2 H, J=2.5 Hz), 1.19 (t, 3 H, J=7.5 Hz).

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(BENZO-4',5' (H) FURAN) PIPERIDIN-1-YL] PROPYL}-CARBOXAMIDO-4-ETHYL-6-(3,4-DIFLUOROPHENYL)-2-OXO- PYRIMIDINE-5 CARBOXYLIC ACID
HYDROCHLORIDE: ¹H NMR δ 8.95 (br s, 1 H), 8.22 (br s, 1 H),

7.40-6.95 (m, 7 H), 6.95 (s, 1 H), 6.63 (s, 1 H),
5.10-4.95 (m, 2 H), 3.40-3.20 (m, 4 H), 3.10-2.80 (m, 4
H), 2.55-2.20 (m, 1 H), 2.15 (m, 1 H), 1.85 (m, 2 H),
1.55-1.30 (m, 4 H), 1.20 (t, 3 H, $J=7.6$ Hz); Anal. Calc.
5 For $C_{22}H_{24}N_4O_2F_2 + HCl + 1.5 H_2O$: C, 56.36; H, 5.87; N,
8.06. Found: C, 56.72; H, 6.11; N, 7.61.

Example 5

1,2,3,4-TETRAHYDRO-1-OXO-2-NAPHTHACETIC ACID METHYL
10 ESTER: Under argon, α -tetralone (5.00 g, 34.2 mmol) in
dry THF (300 mL) was treated with LDA in THF (2 M, 18.8
mL) at -78°C . The solution was stirred at -78°C for 1
h. Methyl bromoacetate (15.7 g, 0.103 mole) was then
15 added to the solution, the mixture was stirred overnight
and allowed to warm to room temperature. The solvent was
evaporated and the residue was dissolved into CHCl_3 (300
mL), washed with water and saturated brine, and then
dried over Na_2SO_4 . After filtration and removal of
solvent, the residue was vacuum distilled. The product,
20 a colorless oil (7.21 g, 96.5%) was collected at $180^\circ\text{C}/1$
mm Hg; ^1H NMR (400 Mhz) δ 1.98 (m, 1H), 2.25 (m, 1H), 2.44
(m, 1H), 2.90-3.20 (m, 4H), 3.73 (s, 3H), 7.10-8.10 (m,
4H); EI mass spectrum M^+ at m/z 218.

25 1-HYDROXY-2-(2-HYDROXYETHYL)-1,2,3,4-TETRAHYDRONAPHTHALEN
E: A solution of 1,2,3,4-tetrahydro-1-oxo-naphthacetic
acid methyl ester (6.15 g, 28.2 mmol) in THF (150 mL) was
treated with LiAlH_4 (2.82 g, 70.5 mmol) and then the
reaction mixture was heated at reflux temperature for 5
30 h. The suspension was cooled to 0°C and quenched by
addition of solid $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$. The mixture was stirred
at room temperature for 4 hrs. The solid was removed by
filtration and concentration of the filtrate *in vacuo*
gave a yellow oil (5.33 g, 98.3%); ^1H NMR indicated the

formation of an isomeric mixture. EI mass spectrum M^+ at m/z 192. The mixture was directly used in next reaction without further purification.

5 2-(2-HYDROXYETHYL)-1,2,3,4-TETRAHYDRO-1-OXO-NAPHTHALENE:
A solution of isomeric mixture of 1-hydroxyl-2-(2-hydroxyethyl)-1,2,3,4-tetrahydronaphthalene (3.00 g, 15.6 mmol) in CH_2Cl_2 (100 mL) was treated with MnO_2 (20.4 g, 0.234 mole). The suspension was stirred at room
10 temperature for 16 h and the solids were removed by filtration. Concentration of the filtrate *in vacuo* gave a brown oil, which was further purified by flash chromatography ($MeOH/CHCl_3$, 5/95), giving a yellow oil (2.00 g, 67.4%): 1H NMR δ 1.76 (m, 1H), 1.98 (m, 1H), 2.21
15 (m, 2H), 2.57 (br, 1H), 2.70 (m, 2H), 3.20 (m, 2H), 3.81 (m, 2H), 7.00-8.20 (m, 4H); CI mass spectrum ($M+1$)⁺ at m/z 191.

20 2-(2-BROMOETHYL)-1,2,3,4-TETRAHYDRO-1-OXONAPHTHALENE: A solution of 2-(2-hydroxyethyl)-1,2,3,4-tetrahydro-1-oxo-naphthalene (2.00 g, 10.5 mmol) in CH_2Cl_2 (100 mL) was treated with PBr_3 (948 mg, 3.50 mmol) at 0 °C. The mixture was stirred at room temperature for 72 h and then poured onto 100 g of ice. The organic layer was
25 separated, washed with aqueous 10% K_2CO_3 solution, H_2O , saturated $NaCl$ and dried over Na_2SO_4 . After filtration and removal of the solvent, the residue was purified by chromatography ($EtOAc$ /hexane, 1/10), giving a yellow oil (1.18 g, 44.4%); 1H NMR δ 1.49 (m, 2 H), 2.24 (m, 1H),
30 2.60 (m, 1H), 2.75 (m, 1H), 3.03 (m, 2H), 3.64 (m, 2H), 7.10-8.10 (m, 4H); EIMS M^+ m/z 223, $M/M+2=1:1$.

2-[2-(4-BENZAMINO-1-PIPERIDYL)ETHYL]-1,2,3,4-TETRAHYDRO-1-OXO-NAPHTHALENE: A mixture of 2-(2-bromoethyl)-

1,2,3,4-tetrahydro-1-oxonaphthalene (1.18 g, 4.66 mmol),
4-benzamidopiperidine (952 mg, 4.66 mmol) and K₂CO₃ (1.29
g, 9.32 mmol) in acetone (200 mL) was stirred at room
temperature for 48 h. The solids were removed by
5 filtration. Concentration of filtrate in vacuo gave a
yellow solid which was purified by chromatography (MeOH:
CHCl₃, 5/95). The product was recrystallized from an
EtOAc/hexane mixture, giving a white powder (268 mg,
15.3%); mp 158-159 °C; ¹H NMR δ 1.53 (m, 2H), 1.67 (m, 1H),
10 1.91 (m, 1H), 2.02 (m, 2H), 2.21 (m, 4H), 2.50 (m, 3H),
2.95 (m, 4H), 4.01 (m, 1H), 5.95 (d, J=8.0 Hz, 1H),
7.20-8.10 (m, 9H); CI MS (M+1) +m/z 377; Anal. Calcd for
C₂₂H₂₄N₂O₂: C, 76.55; H, 7.51; N, 7.44. Found: C, 76.28; H,
7.46; N, 7.37.

Example 6

METHYL

4-(2,1,3-BENZOXADIAZOL-5-YL)-3-[(1-[4-(DIBUTYLAMINO)-
BENZYL]-4-PIPERIDYLMETHYL)AMINO]CARBONYL-6-METHYL-2-OXO-1
20 ,2,3,4- TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: ¹H NMR δ 7.72
(dd, 1 H, J=0.6, 9.6 Hz), 7.70-7.50 (m, 2 H), 7.11 (d, 2
H, J=8.7 Hz), 6.59 (d, 2 H, J=8.7 Hz), 5.90 (s, 1 H),
3.94 (s, 3 H), 3.63 (s, 2H), 3.24 (t, 4 H, J=7.8 Hz),
2.80 (m, 2 H), 2.49 (d, 2 H, J=6.3 Hz), 2.38 (s, 3 H),
25 2.90-1.00 (m, 5 H), 1.54 (p, 4 H, J= 7.8 Hz), 1.35
(sextet, 4 H, J=7.8 Hz), 0.94 (t, 6 H, J=7.8 Hz).

Example 7

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(N'-ETHYL)-N-BENZIMIDAZOLY
30 L- PIPERIDIN-1YL]PROPYL}CARBOXAMIDO-4-METHYL-6-(3,4-
DIFLUOROPHENYL)- 2-OXOPYRIMIDINE HYDROCHLORIDE: ¹H NMR δ
8.95 (t, 1 H, J=3.6 Hz), 7.61 (b, 1 H), 7.60-6.95 (m, 7
H), 6.69 (s, 1 H), 4.36 (m, 1 H), 3.94 (q, 2 H, J=7.2
Hz), 3.72 (s, 3 H), 3.42 (ABm, 4 H), 3.30 (m, 2 H, 4.76

(m, 4 H), 2.43 (s, 3 H), 2.13 (m, 2 H), 1.77 (m, 4 H),
1.33 (t, 3 H, J=7.2 Hz).

Example 8

5 6-(BENZOFURAZAN-5-YL)-1,2,3,6-TETRAHYDRO-5-METHOXYCARBONYL-
L-4- METHYL-2-OXO-1-{N-[3-(4-PHENYLPYPERIDIN-1-YL) PROPYL]
} CARBOXAMIDO-PYRIMIDINE: A solution of 6-(benzofurazan-
5-yl)-1,6-dihydro-2- methoxy-5-methoxycarbonyl-
4-methyl-1-{N-[3-(4-phenylpiperidin-1- yl)propyl]}
10 carboxamidopyrimidine in MeOH was treated with 6 N HCl at
0 C. The solution was stirred at room temperature for 2
h and the MeOH was removed *in vacuo*.
6-(Benzofurazan-5-yl)- 1,2,3,6-tetrahydro-
5-methoxycarbonyl-4-methyl-2-oxo-1-{N-[3-(4-
15 phenylpiperidin-1-yl)propyl]}carboxamidopyrimidine
hydrochloride was obtained as a white powder: mp 134-137
C.

Example 9

20 4-(3-METHOXY)-PHENYL PIPERIDINE: HCl salt; mp 150-154 C;
H NMR δ 2.04 (s, br, 2H), 2.25 (s, br, 2H), 2.80 (s, br,
1H), 3.09 (s, br, 2H), 3.66 (s, 2H), 3.78 (s, 3H), 6.79
(s, br, 3H), 7.23 (s, 1H), 9.41 (s, br, 1H). Anal.
Calcd. For $C_{17}H_{21}NOCl + 0.30 CH_2Cl_2$: C, 58.34; H, 7.40; N,
25 5.53. Found: C, 58.30; H, 7.71; N, 5.35.

(+)-1,2,3,6-TETRAHYDRO-1-N-[4-(3-METHOXY)-PHENYL]-PIPERID
IN-1- YL]-PROPYL-CARBOXAMIDO-4- METHOXYMETHYL-6- (3,4-
DIFLUOROPHENYL)- 2-OXOPYRIMIDINE-5-CARBOXYLIC ACID METHYL
30 ESTER: mp 80-84 C; $[\alpha]_D^{25} = +94.7$, (c = 0.25, MeOH); 1H NMR
 δ 1.74-1.84 (m, 6H), 1.99-2.09 (m, 2H), 2.38-2.51 (m, 3H),
3.03 (d, J=11.1 Hz, 2H), 3.24-3.43 (m, 2H), 3.48 (s,
3H), 3.71 (s, 3H), 3.80 (s, 3H), 4.72 (s, 2H), 6.68 (s,
1H), 6.72-6.84 (m, 3H), 7.05-7.11 (m, 2H), 7.15-7.27 (m,

2H), 7.72 (s, 1H), 8.84 (t, J=5.4 Hz, 1H). Anal. Calcd. For C₂₁H₂₄N₄O₄F₂Cl: C, 57.8; H, 6.0; N, 9.0. Found: C, 57.61; H, 6.57; N, 6.97.

5 **Example 10**

(+)-1,2,3,6-TETRAHYDRO-1-(N-[4-(3,-ACETAMIDO)-PHENYL-PIPERIDIN-1-YL]PROPYL)CARBOXAMIDO-4-METHOXYMETHYL-6-(3,4-DIFLUORO-PHENYL)-2-OXOPYRIMIDINE-5-CARBOXYLIC ACID METHYLESTER: mp 135-138 °C; [α]_D = +105.5, (c = 0.11, MeOH);
10 ESMS, 614.25 (M+1); ¹H NMR δ 1.76-1.87 (m, 6H), 2.03-2.13 (m, 2H), 2.18 (s, 3H), 2.49 (t, J=6.9 Hz, 3H), 3.10 (d, J=11.1 Hz, 2H), 3.30-3.42 (m, 2H), 3.46 (s, 3H), 3.71 (s, 3H), 4.68 (s, 2H), 6.68 (s, 1H), 6.96 (d, J=7.5 Hz, 1H), 7.04-7.11 (m, 2H), 7.16-7.26 (m, 2H), 7.34 (d, J=6.3 Hz, 1H),
15 7.45 (s, 1H), 7.94 (s, 1H), 8.97 (t, J=5.4 Hz, 1H); ESMS, M+1 614.25

The compound of Example 10 may also be prepared via hydrogenation of the compound of example 2 (H₂ balloon method, methanol, Pd/C, overnight). A synthetic path
20 analogous to the latter route (Scheme 11) was used in the preparation of the tritiated analog, which in turn, was used as a radioligand in the MCH pharmacological assays.

25 **Example 11**

3-(4-PHENYLPYPERIDIN-1-YL)PROPIONITRILE: Acrylonitrile (3.1 mL, 44 mmol, 2.5 eq) was added to a solution of 4-phenylpiperidine (3.00 g, 18.0 mmol) in EtOH (40 mL) and the mixture was stirred at room temperature for 1.5
30 h. The volatiles were removed, giving 3.80 g of the desired product (brown oil, 99%).

3-(4-PHENYLPYPERIDIN-1-YL)PROPYLAMINE: A solution of BH₃ in THF (1.0 M, 83.0 mL, 83.0 mmol, 3.5 eq) was added to a

stirring solution of 3-(4-phenylpiperidin-1-yl)-
propionitrile (5.10 g, 24.0 mmol) in anhydrous THF (20
mL) under argon at room temperature. The mixture was
heated at reflux temperature for 4.5 hours and then
5 cooled to room temperature. Aqueous 6 N HCl (130 mL) was
added and stirring was continued for 2 hours at 50-70 °C.
The mixture was basified to pH 9 by addition of aqueous 6
N NaOH and extracted with EtOAc (100 mL) and CH₂Cl₂ (3 x
100 mL). The combined organic extracts were dried over
10 magnesium sulfate and concentrated. The residue was
dissolved in CH₂Cl₂ (20 mL) and treated with HCl in ether
(1.0 M, 50 mL). The solvents were removed, ether (250
mL) was added, the mixture was filtered, and the filter
cake was washed with ether. Water (60 mL) was added to
15 the resulting white solid, 1 N NaOH was added until pH
10-11 was reached, and then the aqueous phase was
extracted with CH₂Cl₂ (3 X 50 mL). The combined extracts
were dried over magnesium sulfate and the solvents were
evaporated, giving the desired product (4.50 g, 87%).

20 6-(3,4-DIFLOUROPHENYL)-1,2,3,6-TETRAHYDRO-5-METHOXYCARBON
YL-4-METHYL-2-OXO-1-{N-[3-(4-PHENYLPYPERIDIN-1-YL)
PROPYL]}CARBOXAMIDO-PYRIMIDINE: A solution of 6-(3,4-
difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxy
25 carbonyl-4-methyl-1-{N-[3-(4-phenyl-piperidin-1-yl)
propyl]}carboxamidopyrimidine (100 mg, 0.185 mmol, mp =
43-45 °C) in MeOH (5 mL) was treated with aqueous 6 N HCl
(1.5 mL) at 0 °C. The solution was stirred at room
temperature for 2 hrs and MeOH was removed *in vacuo*.
30 6-(3,4-Diflouropheryl)-1,2,3,6-tetrahydro-
5-methoxycarbonyl-4-methyl-2-oxo-1-{N-[3-(4-
phenylpiperidin-1-yl)propyl]}carboxamidopyrimidine
hydrochloride was obtained as a white powder (89 mg,
86%). mp 133-136 °C.

Example 12

3-((3,4,5-TRIFLUOROPHENYL)METHYLENE)-2,4-PENTANEDIONE: A stirring mixture of 3,4,5-trifluorobenzaldehyde (4.2 g, 26.2 mmol), 2,4-pentanedione (2.62 g, 26.2 mmol),
5 piperidine (0.430 g, 5 mmol) in benzene (150 mL) was heated at reflux temperature (equipped with a Dean-Stark trap) for 8 h. The benzene was evaporated, the yellow oily residue, 2-((3,4,5-trifluorophenyl)-methylene)-2,4-pentanedione, was used in the next step without further
10 purification.

6-(3,4,5-TRIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-ACETYL-4-METHYLPYRIMIDINE: A stirring mixture of 2-((3,4,5-trifluoro-phenyl)methylene)-2,4-pentanedione (26.2 mmol),
15 O-methylisourea hydrogen sulfate (3.22 g, 39.3 mmol), and NaHCO₃ (6.60 g, 78.6 mmol) in EtOH (400 mL) was heated at 95-100 °C for 6 h. The mixture was filtered, the solid residue was washed with ethanol (100 mL). The solvent was evaporated from the combined filtrates and the crude
20 product was purified by flash column chromatography (EtOAc/hexane, 9/1 to 4/1), giving the desired product as an oil (2.80 g, 36%).

6-(3,4,5-TRIFLUOROPHENYL)-1,6-DIHYDRO-2-METHOXY-5-ACETYL-4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE:
25 4-Nitrophenyl chloroformate (1.886 g, 9.38 mmol) was added to a solution of 6-(3,4,5-trifluorophenyl)-1,6-dihydro-2-methoxy-5-acetyl-4-methylpyrimidine (2.80 g, 9.38 mmol) and pyridine (10 mL) in CH₂Cl₂ (200 mL) at
30 0-5 °C and then the mixture was allowed to warm to room temperature. After 12 h, the solvent was evaporated and the residue was purified by flash chromatography (CH₂Cl₂/EtOAc, 9/1 to 20/3), giving the desired product as a white powder (4.0 g, 92%).

6-(3,4,5-TRIFLUOROPHENYL)-1,2,3,6-TETRAHYDRO-2-OXO-5-ACETYL-4-METHYL-1-[(4-NITROPHENYLOXY)CARBONYL]PYRIMIDINE:
Aqueous 6 N aqueous HCl (4 mL) was added to a stirring solution of 6-(3,4,5-trifluorophenyl)-1,6-dihydro-2-methoxy-5-acetyl-4-methyl-1-[(4-nitrophenyloxy)carbonyl]pyrimidine (4.0 g, 8.63 mmol) in THF (100 mL) at 0-5 C, and the mixture was allowed to warm to room temperature. After 2 h, the solvent was evaporated and the product was dried under vacuum, giving the desired product as a pure single component which was used in the next step without further purification (3.88 g, 100%).

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(4-FLUOROPHENYL)-PIPERIDINE-1-YL]-PROPYL}CARBOXAMIDO-5-ACETYL-2-OXO-6-(3,4,5-TRIFLUOROPHENYL)-4-METHYLPYRIMIDINE HYDROCHLORIDE: ^1H NMR δ 7.20-6.86 (m, 6 H), 6.64 (s, 1 H), 5.56 (s, 1 H), 3.70-3.80 (m, 2 H), 3.43-3.35 (m, 2 H), 3.19-2.98 (m, 2 H), 2.40 (s, 3 H), 2.28 (s, 3 H), 2.50-1.60 (m, 8 H).

20

Example 13

N1-[4-([4-(DIBUTYLAMINO)BENZYL]AMINOMETHYL)CYCLOHEXYL]-1-NAPHTH-AMIDE: ^1H NMR δ 8.26 (dd, 1 H, $J=2.1, 7.2$ Hz), 7.87 (m, 2 H), 7.51 (m, 2 H), 7.40 (apparent t, 1 H, $J=7.8$ Hz), 7.17 (d, 1 H, $J=8.7$ Hz), 6.61 (d, 2 H, $J=8.7$ Hz), 5.94 (d, 1 H, $J=8.1$ Hz), 4.04 (m, 1 H), 3.76 (m, 1 H), 3.63 (m, 2 H), 3.21 (t, 4 H, $J=7.6$ Hz average), 2.53 (d, 2 H, $J=6.7$ Hz), 2.10, ABm, 4 H), 1.55 (p, 4 H, $J=7.7$ Hz average), 1.34 (sept, 4 H, $J=7.6$ Hz average), 1.17 (m, 4 H), 0.95 (t, 6 H, $J=7.6$ Hz average).

30

Example 14

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(1-NAPHTHYL)-PIPERIDIN-1-YL]PROP-YL}CARBOXAMIDO-4-METHOXYMETHYL-6-(3,4-

DIFLUOROPHENYL)-2-OXO-PYRIMIDINE-5-CARBOXYLIC ACID METHYL
ESTER: mp 168-172 °C; $[\alpha]_D^{25} = +94.7$, (c = 0.25, MeOH); ^1H
NMR δ 1.75-1.84 (m, 2H), 1.87-2.01 (m, 4H), 2.14-2.28 (m,
2H), 2.47 (t, J=7.2 Hz, 2H), 3.10 (d, J=11.1 Hz, 2H),
5 3.28-3.45 (m, 3H), 3.48 (s, 3H), 3.71 (s, 3H), 4.68 (s,
2H), 6.70 (s, 1H), 7.05-7.12 (m, 2H), 7.16-7.24 (m, 1H),
7.42-7.54 (m, 4H), 7.69-7.75 (m, 2H), 7.85 (d, J=11.4 Hz,
1H), 8.09 (d, J=11.1 Hz, 1H), 8.91 (t, J=5.4 Hz, 1H).

10 **Example 15**

4-(5-FLUORO-2-METHOXY)PHENYL PIPERIDINE: mp 254-258 °C; ^1H
NMR δ 1.53-1.68 (m, 2H), 1.79 (d, J=11.7 Hz, 2H), 2.12 (dt,
J=2.1 Hz, J=11.7 Hz, 1H), 2.77 (dt, J=1.8 Hz, J=12.3 Hz,
1H), 2.90-3.05 (m, 1H), 3.10-3.22 (m, 2H), 3.68 (s, 1H),
15 3.79 (s, 3H), 6.72-6.93 (m, 3H). Anal. Calcd. For
 $\text{C}_{17}\text{H}_{19}\text{NOF}$ + 0.14 CH_2Cl_2 : C, 56.60; H, 6.76; N, 5.44.
Found: C, 56.60; H, 6.92; N, 5.28.

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(5-FLUORO-2-METHOXY)PHENYL
20 PIPERIDIN-1-YL]PROPYL}CARBOXAMIDO-4-METHOXYMETHYL-6-
(3,4-DIFLUORO-PHENYL)-2-OXOPYRIMIDINE-5-CARBOXYLIC ACID
METHYL ESTER: ^1H NMR δ 8.93 (t, 1 H, J=5.4 Hz), 7.76 (br, 1
H), 7.30-6.69 (m, 7 H), 4.69 (s, 2 H), 3.79 (s, 3 H),
3.71 (s, 3 H), 3.48 (s, 3 H), 3.38 (m, 2 H), 3.10-2.80
25 (m, 3 H), 2.42 (t, 2 H, J=7.2 Hz), 2.07 (dt, 2 H, J=3.0,
8.4 Hz), 2.00-1.60 (m, 6 H).

Example 16

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-HYDROXY-4-(2-PYRIDYL)-PIPE
30 RIDIN-1-YL]PROPYL}CARBOXAMIDO-4-METHOXYMETHYL-6-
(3,4-DIFLUOROPHENYL)-2-OXOPYRIMIDINE-5-CARBOXYLIC ACID
METHYL ESTER: mp 132-135 °C; $[\alpha]_D^{25} = +94.7$, (c = 0.25,
MeOH); ^1H NMR δ 1.47 (d, J=11.7 Hz, 2H), 1.74-1.85 (m, 2H),
2.43-2.63 (m, 9H), 2.87 (d, J=10.2 Hz, 2H), 3.30-3.47 (m,

2H), 3.49 (s, 3H), 3.71 (s, 3H), 4.69 (s, 2H), 6.69 (s, 1H), 7.04-7.21 (m, 4H), 7.49 (dd, J=0.6 Hz, J=6.9 Hz, 1H), 7.72 (s, br, 1H), 8.36 (dd, J=1.2, 4.8 Hz, 1H), 8.89 (t, J=5.4 Hz, 1H).

5

Example 17

1-(3-AMINOPROPYL)-4-[2-PYRIDYL]PYRIDINIUM BROMIDE

10 HYDROBROMIDE: A solution of 2,4'-dipyridyl (25.0 g, 160 mmol) and 3-bromopropyl-amine hydrobromide (35.0 g, 160 mmol) in DMF (60 mL) was heated at 90-95 °C for 10 h. After cooling to room temperature, anhydrous ether (500 mL) was added to the mixture, the resulting white solid was filtered, washed with Et₂O and dried, giving
15 1-(3-aminopropyl)-4-[2-pyridyl]pyridinium bromide hydrobromide (60 g, 100%). ¹H NMR (DMSO-d₆) δ 2.35-2.44 (m, 2 H), 3.08-3.13 (m, 2 H), 4.76-4.81 (m, 2 H), 7.58 (dd, J=4.8 Hz, J=7.5 Hz, 1 H), 8.03 (dt, J=1.8 Hz, J=7.8 Hz, 1 H), 8.32 (d, J=7.8 Hz, 1 H), 8.77-8.81 (m, 3 H),
20 9.12 (d, J=6.3 Hz, 2 H). Anal. Calcd. for C₁₃H₁₆N₂Br + HBr + 0.5 H₂O: C, 40.65; H, 4.72; N, 10.94. Found: C, 40.83; H, 4.37; N, 11.05.

25 3-(3',6'-DIHYDRO-2'-H-[2,4']BIPYRIDINYL-1'-YL)-PROPYLAMINE: NaBH₄ (2 g, 53 mmol) in small portions was added to a solution of 1-(3-aminopropyl)-4-[2-pyridyl]pyridinium bromide hydrobromide (6 g, 16 mmol) in MeOH (150 mL) at 0-5 °C over a period of 2 h. The reaction mixture was stirred overnight at room temperature and then the
30 solvent was evaporated. The residue was suspended in ether (200 mL) and treated with aqueous 50% NaOH solution (100 mL). The ether layer was separated and the aqueous layer was extracted with additional ether (2 X 50 mL). The combined ether extracts were dried over potassium
35 carbonate and the solvent was removed, giving

3-(3',6'-dihydro-2'-H-[2,4']bipyridinyl-1'-yl)-propylamine (3.48 g) as an oil. The crude product was used in the next step immediately without further purification.

5

3-AMINOPROPYL-4-(2-PYRIDYL)PIPERIDINE: A suspension of 3-(3',6'-dihydro-2'-H-[2,4']bipyridinyl-1'-yl)-propylamine (3.48 g crude, 15.9 mmol) and Pearlman's catalyst (1.0 g) in MeOH (40 mL) was hydrogenated under 120 psi for 10 h, after which the reaction mixture was filtered through a pad of Celite and the solvent was removed. The residue was purified by column chromatography over silica gel (30 g) [Note: If a large excess of silica gel is used the recovery of the product will be very low] (CH₂Cl₂/methanol/2M NH₃ in MeOH, 90/8/4 to 90/40/40). The product was obtained as a pale yellow oil (3.21 g, 91%). ¹H NMRδ (CD₃OD) 1.50-1.99 (m, 10 H), 2.02-2.06 (m, 2 H), 2.37-2.75 (m, 3 H), 3.02-3.06 (br m, 2 H), 7.05-7.09 (m, 4 H), 7.16 (dt, J=0.9 Hz, J=8.7 Hz, 1 H), 8.48 (dd, J=0.9 Hz, J=4.2 Hz, 1 H).

10

15

20

Part II

(+)-6-(3,4-DIFLUOROPHENYL)-1-{N-[4-(2-PYRIDYL)PIPERIDIN-1-YL]-PROPYL} CARBOXAMIDO-5-METHOXYCARBONYL-4-METHOXYMETHYL-2-OXO-1,2,3,6-TETRAHYDROPYRIMIDINE DIHYDROCHLORIDE

25

5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-OXO-6-(3,4-DIFLUOROPHENYL)-PYRIMIDINE: Copper(I) oxide (5.06 g, 0.035 mole) and acetic acid (2.05 mL) were added sequentially to a stirring solution of methyl 4-methoxyacetoacetate (50.0 g, 0.351 mol), 3,4-difluorobenzaldehyde (51.4 g, 0.351 mmol), and urea (31.6 g, 0.527 mole) in THF (300 mL) at room temperature, followed by dropwise addition of boron trifluoride

30

35

diethyl etherate (56.0 mL, 0.456 mole). The mixture was stirred at reflux temperature for 8 h, whereupon TLC (1/1 EtOAc/hexanes) indicated completion of the reaction. The reaction mixture was cooled and poured into a mixture of ice and sodium bicarbonate (100 g) and the resulting mixture was filtered through Celite. The Celite pad was washed with dichloromethane (400 mL). The organic layer was separated from the filtrate and the aqueous layer was extracted with more dichloromethane (3 X 300 mL). The combined organic extracts were dried (sodium sulfate) and the solvent was evaporated. The crude product was purified by flash chromatography (ethyl acetate/hexanes, 1/1; then ethyl acetate), giving the desired product as a pale yellow foam. The foam was triturated with hexanes, giving a white powder (103.3 g, 94%). ^1H NMR δ 3.476 (s, 3H), 3.651 (s, 3H), 4.653 (s, 2H), 5.39 (s, 1H), 6.60 (br s, 1H, NH), 7.00-7.20 (m, 3H), 7.72 (br s, 1H, NH).

(+)-5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-OXO-6-(3,4-DIFLUOROPHENYL)-PYRIMIDINE: The racemic intermediate 5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)pyrimidine was resolved by chiral HPLC [Chiralcel OD 20 X 250 mm #369-703-30604; λ 254 nm; hexanes/ethanol 90/10 ; 85 mg per injection; retention time of the desired enantiomer: 16.94 min., the first enantiomer peak to elute], giving (+)-5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-pyrimidine (40-42 wt% isolation of the desired enantiomer from the racemate); $[\alpha]_D = +83.8$ (c = 0.5, chloroform).

(+)-5-METHOXYCARBONYL-4-METHOXYMETHYL-1,2,3,6-TETRAHYDRO-2-OXO-6-(3,4-DIFLUOROPHENYL)-1-[(4-NITROPHENYLOXY)CARBONYL]

L]PYRIMIDINE: A solution of lithium hexamethyldisilazide in THF (1M, 18.0 mL, 18.0 mmol) was added over 2-3 min. to a solution of (+)-5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-pyrimidine (1.98 g, 6.34 mmol) in anhydrous THF (20 mL) at -78 C under argon atmosphere and the mixture was stirred for 10 min. The resulting solution was added over 6 min., via a cannula, to a stirred solution of 4-nitrophenyl chloroformate (4.47 g, 22.2 mmol) in THF (20 mL) at -78 C. The mixture was stirred for an additional 10 min. and the mixture was poured onto ice (50 g) and extracted with chloroform (2 X 50 mL). The combined extracts were dried (sodium sulfate) and the solvent evaporated. The residue was purified by flash chromatography (hexanes/ethyl acetate, 4/1 to 3.5/1), giving the product as a yellow syrup, which on trituration with hexanes became a white powder (2.40 g, 79%). ¹H NMR δ 3.52 (s, 3H), 3.74 (s, 3H), 4.65-4.80 (q, J=16.5 Hz, 2H), 6.32 (s, 1H), 7.10-7.30 (m, 4H), 7.36 (d, J=9 Hz, 2H), 8.27 (d, J=9 Hz, 2H).

(+)-6-(3,4-DIFLUOROPHENYL)-1-{N-[4-(2-PYRIDYL)PIPERIDIN-1-YL]-PROPYL}CARBOXAMIDO-5-METHOXYCARBONYL-4-METHOXYMETHYL-2-OXO-1,2,3,6-TETRAHYDROPYRIMIDINE
DIHYDROCHLORIDE: A solution of (+)-5-methoxycarbonyl-4-methoxymethyl-1,2,3,6-tetrahydro-2-oxo-6-(3,4-difluorophenyl)-1-[(4-nitrophenyloxy)carbonyl]pyrimidine (2.38 g, 5 mmol), 3-aminopropyl-4-(2-pyridyl)piperidine (1.21 g, 5.5 mmol) in THF (20 mL) was stirred at room temperature for 12 h. The solvent was evaporated and the residue was re-dissolved in ethyl acetate (100 mL). The resulting solution was washed with ice-cold 1 N NaOH (4 X 50 mL), brine (2 X 50 mL) and dried over potassium carbonate. The solvent was evaporated *in vacuo* and the residue was purified by flash chromatography (dichloromethane/MeOH/2 M ammonia in MeOH, 980/10/10 to 940/30/30), giving a

clean fraction of the desired product (2.45 g, 88%) as a foam and a slightly impure fraction (0.30 g, 10%). ¹H NMR δ 1.60-2.00 (m, 6H), 2.05-2.15 (m, 2H), 2.38-2.43 (br t, 2H), 2.65-2.80 (m, 1H), 3.05-3.06 (br d, 2H), 3.30-3.45 (m, 2H), 3.48 (s, 3H), 3.704 (s, 3H), 4.68 (s, 2H), 6.68 (s, 1H), 7.05-7.20 (m, 5H), 7.58-7.63 (dt, 1H), 7.70 (s, 1H, NH), 8.50-8.52 (dd, 1H), 8.88 (br t, 1H).

The HCl salt was prepared by treatment of a solution of the free base in ether with 1 N HCl in ether. The white powder was dried under reduced pressure: ¹H NMR δ 2.05-2.20 (m, 4H), 2.77-2.88 (m, 2H), 3.00-3.20 (m, 4H), 3.35-3.47 (m, 2H), 3.47 (s, 3H), 3.64-3.70 (m, 2H), 3.71 (s, 3H), 4.05 (br t, 1H), 4.67 (s, 2H), 6.59 (s, 1H), 7.05-7.20 (m, 3H), 7.79 (t, 1H), 8.00 (d, 1H), 8.43 (dt, 1H), 8.96 (br t, 1H, NH), 12.4 (br s, 1H). m.p. 188-191 C; [α]_D = +141.13 (c = 0.265, MeOH); Anal. Calcd. for C₂₄H₂₈N₄O₄FCl + 0.6 H₂O: C, 52.36; H, 5.84; N, 10.90. Found: C, 52.24; H, 5.96; N, 10.80. (Note: NMR analysis of this product did not show the presence of any water. However, it was noted by the lab that performed the elemental analysis that this sample gains weight during handling by absorbing water from the atmosphere).

Example 18

(1)-1,2,3,6-TETRAHYDRO-1-(N-[4-(ISOBENZOFURAN) PIPERIDINE-1-YL]-PROPYL)CARBOXAMIDO-5-METHOXYCARBONYL-2-OXO-6-(3,4-BENZOFURAZAN)-4-METHYLPYRIMIDINE HYDROCHLORIDE

4-(3,4-BENZOFURAZAN)-6-METHYL-2-OXO-3-{[3-(4-SPIRO[ISOBENZOFURAN-1(3H),4'-PIPERIDINE]PROPYL)-1,2,3,4-TETRAHYDROPYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER : 1-(3-Aminopropyl)-4- spiro[iso-benzofuran-1 (3H),4'-

piperidine] (0.028 g, 0.110 mmol) was added to
(±)-6-(benzofurazan)-1,6-dihydro-2-methoxy-
5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)carbonylpyri
midine (0.047 g, 0.100 mmol) in dry dichloromethane (10
5 mL) and the solution was stirred at room temperature for
24 h. Aqueous 6 N HCl (2 mL) was added to the reaction
mixture which was stirred for another 1 h. The reaction
mixture was basified with aqueous 10% KOH solution (pH =
9) and extracted into dichloromethane (3 x 10 mL). The
10 organic layer was dried over sodium sulfate, filtered and
concentrated. The crude product was purified by flash
chromatography (EtOAc/ MeOH, 4.5/0.5), giving the desired
product (41.0 mg, 73 %) as a syrup: ¹H NMR δ 1.76-1.81
(m, 7 H), 1.94-2.04 (m, 6 H), 2.32-2.48 (m, 1 H), 2.83
15 (d, J=10.6 Hz, 2 H), 3.36-3.43 (m, 2 H), 3.75 (s, 3 H),
5.05 (s, 2 H), 6.83 (s, 1 H), 7.07-7.27 (m, 4 H), 7.54
(d, J=9.5 Hz, 1 H), 7.69 (s, 1 H), 7.78 (d, J=9.5 Hz, 1
H), 8.85 (d, J=5.2 Hz, 1 H).

20 HCl in ether (1 N, 5 mL) was added to the free base
(0.041 g, 0.073 mmol) in dichloromethane (4 mL), and the
solution was concentrated under reduced pressure. The
product was recrystallized from ether, giving the
hydrochloride salt as a pale yellow solid (42.0 mg, 96
25 %); mp 180-182 °C; Anal. Calcd. for C₂₂H₂₄N₆O₆Cl + 0.5 moles
H₂O: C, 57.47; H, 5.65; N, 13.87. Found: C, 57.42; H,
5.71; N, 13.70.

Example 19

30 2-(3,4-DIFLUOROPHENYL)4,5-DIHYDROIMIDAZOLE-1-CARBOXYLIC
ACID {3-[4-PHENYL-4-(4-BROMO-5-METHYLTHIOPHEN-2-YL)]
-PROPYL}-AMIDE: Anal. Calcd. for C₃₅H₂₇N₄O₅ClF₂ + HCl + 1.5
H₂O: C, 55.26; H, 6.03; N, 8.59. Found: C, 55.29; H, 5.95;
N, 8.39.

Example 20

4-(3,4-DIFLUOROPHENYL)-6-METHYL-2-OXO-3-([3-(4-SPIRO[ISOBENZOFURAN-1(3H),4'-PIPERIDINE]PROPYL)-1,2,3,4-TETRAHYDOPYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER

5 For the preparation of the ether piperidine precursor of the compound of Example 20, refer to W.E.Parham et al, *J. Org. Chem.* (1976) 41, 2268.

10 1-TERT-BUTOXYCARBONYL-3-(4-SPIRO[ISOBENZOFURAN-1(3H),4'-PIPERIDINE])PROPYLAMINE: N-(tert-butoxycarbonyl)-3-bromopropylamine (0.772 g, 3.27 mmol) and potassium carbonate (0.904 g, 6.54 mmol) were added to a stirring solution of the amine (0.566 g, 3.27 mmol) in dioxane (20 mL) and the reaction mixture was heated at reflux temperature for
15 24 h. The reaction mixture was cooled to room temperature, concentrated and partitioned between chloroform (40 mL) and water (5 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by column chromatography
20 (ethyl acetate/ methanol, 4.5/0.5), giving the desired product (0.856 g, 79 %) as a colorless oil; ¹H NMR δ 1.45 (s, 9 H), 1.63-2.04 (m, 6 H), 2.33-2.52 (m, 4 H), 2.87 (d, J=11.0 Hz, 2 H), 3.2 (br s, 2 H), 5.07 (s, 2 H), 5.6 (br s, 1 H), 7.13-7.28 (m, 4 H).

25

3-(4-SPIRO[ISOBENZOFURAN-1(3H),4'-PIPERIDINE])PROPYLAMINE: Trifluoroacetic acid (1 mL) was added to 1-tert-butoxycarbonyl 3-(4-spiro[isobenzofuran-1(3H),4'-piperidine])propylamine (0.500 g, 1.51 mmol) in
30 dichloromethane (5 mL) and the solution was stirred at room temperature for 1 h. The reaction mixture was concentrated, neutralized with 10 % KOH solution and extracted into dichloromethane (25 mL). The organic layer was dried over sodium sulfate, filtered and

concentrated, giving the desired amine (0.340 g, 98%) which was used in the subsequent step without further purification.

5 4-(3,4-DIFLUORPHENYL)-6-METHYL-2-OXO-3-([3-(4-SPIRO[ISOBENZOFURAN-1(3H),4'-PIPERIDINE]PROPYL)-1,2,3,4-TETRAHYDOPYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER:
3-(4-spiro[isobenzofuran-1(3H),4'-piperidine])
propylamine (0.0319 g, 0.123 mmol) was added to
10 (±)-6-(3,4-Difluorophenyl)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)carbonylpyrimidine (0.052 g, 0.112 mmol) in dry dichloromethane (10 mL) and the solution was stirred at room temperature for 24 h. Aqueous 6 N HCl (2 mL) was added and the reaction
15 mixture was stirred for an additional 1 h. After neutralization with 10% aqueous KOH solution, the reaction mixture was extracted with dichloromethane (3 x 10 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was
20 purified by flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving the desired product (0.040 g, 64 %) as a syrup;
1H-NMR δ 1.73-1.78 (m, 7 H), 1.93-2.04 (m, 2 H), 2.33-2.48 (m, 6 H), 2.83 (d, J=11.8 Hz, 2 H), 3.35-3.41 (m, 2 H), 3.71 (s, 3 H), 5.06 (s, 2 H), 6.75 (s, 1 H), 7.04-7.26
25 (m, 7 H), 8.82 (t, J=5.1 Hz, 1 H).

A solution of 1 N HCl in ether (5 mL) was added to the free base (0.040 g, 0.072 mmol) in dichloromethane (4 mL) and the solution was concentrated *in vacuo*. The product
30 was recrystallized from ether, giving the dihydrochloride as a pale yellow solid (0.042 g, 99 %); mp 178-182 C;
Anal. Calcd. for $C_{21}H_{24}F_2N_4O \cdot Cl_2 + 0.6 H_2O$: C, 57.87; H, 5.73, N 9.31. Found: C, 58.11; H 5.90; N 8.95.

Example 21

1,2,3,6-TETRAHYDRO-1-{N-[4-(DIHYDROINDENE)-1-YL}PROPYL}CARBOXYAMIDO-5-METHOXYCARBONYL-2-OXO-6-(3,4-BENZOFURAZAN)-4-METHYLPYRIMIDINE

5

For the preparation of the indane piperidine precursor of the compound of Example 21, refer to M.S.Chambers *J. Med. Chem.* (1992) 35,2033.

10

N-(tert-butoxycarbonyl)-3-(4-spiro[isobenzofuran-1(3H),4'-piperidine])propylamine (1.10 g, 4.64 mmol) and potassium carbonate (1.17 g, 8.44 mmol) were added to a stirring solution of the amine (0.790 g, 4.22 mmol) in dioxane (20 ml), and the resulting solution was heated at reflux temperature for 24 h. The reaction mixture was cooled to room temperature, concentrated and partitioned between chloroform (40 mL) and water (5 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by column chromatography (ethyl acetate/methanol, 4.5/0.5), giving the desired product (0.886 g, 61 %) as a colorless oil; ¹H NMR δ 1.46 (s, 9 H), 1.55 (d, J = 11.3 Hz, 2 H), 1.69 (t, J = 6.3 Hz, 2 H), 1.88-2.47 (m, 6 H), 2.47 (t, J = 6.3 Hz, 2 H), 2.88 (t, J = 3.3 Hz, 4 H), 3.23 (d, J = 5.6 Hz, 2 H), 5.85 (br s, 1 H), 7.18 (s, 4 H).

15

20

25

30

Trifluoroacetic acid (1 ml) was added to 1-tert-butoxycarbonyl-3-(4-spiro[isobenzofuran-1(3H),4'-piperidine])propylamine (0.180 g, 0.52 mmol) in dichloromethane (5 ml) and the resulting solution was stirred at room temperature for 1 hour. The solution was concentrated, neutralized with 10% KOH solution and extracted into dichloromethane (25 ml). The organic layer was dried over sodium sulfate, filtered and

concentrated, giving propylamine (0.156 g, 100%) which was used in the subsequent step without further purification.

5 (±)-4-(3,4-BENZOFURAZAN)-6-METHYL-2-OXO-3-{SPIRO[1H-INDAN
E-1,4'-PIPERIDINE]PROPYL}-1,2,3,4-TETRAHYDROPYRIMIDINE-5-
CARBOXYLIC ACID METHYL ESTER HYDROCHLORIDE: To
 (±)-4-(3,4-benzofurazan)-1,6- dihydro-2-methoxy-5-
methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)-
10 carbonylpyrimidine (0.059 g, 0.126 mmol) in dry
dichloromethane (10 mL), 1-(3-aminopropyl)spiro
[1H-indane-1,4'- piperidine] (0.062 g, 0.252 mmol) was
added and the solution was stirred at room temperature
for 24 h. The reaction mixture was stirred for another 1
15 h after addition of 2 mL of 6N HCl. The reaction mixture
was basified with 10% aqueous KOH solution (pH = 9) and
extracted with dichloromethane (3 x 10 mL). The combined
organic extracts were dried over sodium sulfate, filtered
and concentrated. The crude product was purified by
20 flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving 0.070
g (100%) of the desired product as a syrup: ¹H NMR δ 1.51
(d, J=12.5 Hz, 2 H), 1.76-2.08 (m, 4 H), 2.12 (t, J=10.3
Hz, 2 H), 2.45 (s, 5 H), 2.86-2.91 (m, 4 H), 3.30-3.45
(m, 2 H), 3.75 (s, 3 H), 6.83 (s, 1 H), 7.02 (br s, 1 H),
25 7.0 (m, 4 H), 7.54 (d, J=9.6 Hz, 1 H), 7.69 (s, 1 H),
7.78 (d, J=9.2 Hz, 1 H), 8.84, (t, J=5.2 Hz, 1 H).

To the free base (0.070 g, 0.125 mmol) in 4 mL of
dichloromethane, 5 mL of 1 N HCl in ether was added, and
30 the solution was concentrated under reduced pressure.
Recrystallization from ether gave 0.088 g (100 %) of
(±)-4-(3,4-benzofurazan)-6-methyl-2-oxo-3-{spiro[1H-indan
e- 1,4'-piperidine]propyl}-1,2,3,4-tetrahydro-
pyrimidine-5-carboxylic acid methyl ester hydrochloride
35 as a white solid: m.p. 155-157 °C; Anal. Calcd. for

C₂₉H₃₃N₅O₄·Cl: C, 57.12; H, 5.76; N, 13.33. Found: C, 57.40; H, 5.96; N, 13.02.

Example 22

5 (+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(BENZO-4',5'(H)FURAN)PIPERIDIN-1-YL]PROPYL}CARBOXAMIDO-4-ETHYL-6-(3,4-DIFLUOROPHENYL)-2-OXO-PYRIMIDINE-5-CARBOXAMIDE
10 HYDROCHLORIDE: DMAP·ECD (0.250 mmol, 0.050 g) was added to a stirred mixture of (+)-1,2,3,6-tetra-hydro-1-{N-[4-(benzo-4',5'(h)furan)piperidin-1-yl]propyl}carbox-amido-4-ethyl-6-(3,4-difluorophenyl)-2-oxo-pyrimidine-5-carboxyl-ic acid hydrochloride (0.100 mmol, 0.055 g) and N-methylmorpholine (0.330 mL) in dry dichloromethane (10 mL). The resulting mixture was stirred at room
15 temperature for 1 h and quenched with NH₃. The reaction mixture was stirred at room temperature overnight, concentrated and chromatographed, giving the desired product. The HCl salt was prepared by the addition of HCl in ether to a solution of the product in
20 dichloromethane, followed by evaporation of the solvents. Anal. Calc. For C₂₉H₃₃N₅O₄·F₂ + HCl + 0.7 CHCl₃: C, 52.96; H, 5.29; N, 9.40. Found: C, 52.81; H, 5.69; N, 8.97.

Example 23

25 (1)-1,2,3,6-TETRAHYDRO-1-{N-[4-(3,4-DIHYDRO-2-OXOSPIRO-NAPHTHALENE-1(2H))-PIPERIDINE-1-YL]PROPYL}CARBOXAMIDO-5-METHOXYCARBONYL-2-OXO-6-(3,4-BENZOFURAZAN)-4-METHYLPYRIMIDINE HYDROCHLORIDE
30 1-(3-TERT-BUTOXYCARBONYLAMINOPROPYL)SPIRO[ISOCHROMAN-3,4'-PIPERIDIN]-1-ONE: To a stirred solution of spiro [piperidine-4,1'-tetralin] To a stirred solution of spiro[isochroman-3,4'-piperidin]-1-one (K.Hashigaki et al. *Chem.Pharm.Bull.* (1984) 32, 3568.) (0.587 g, 2.58
35 mmol) in dioxane (20 mL), N-(tert-butoxycarbonyl)-

3-bromopropylamine (0.615 g, 2.84 mmol) and potassium carbonate (0.714 g, 5.17 mmol) were added and the solution was refluxed for 24 h. The reaction mixture was cooled to room temperature, concentrated and partitioned between 40 mL chloroform and 5 mL water. The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by column chromatography (ethyl acetate/ methanol, 4.5/0.5) to yield 0.465 g (47 %) of the desired product as a colorless oil; ¹H NMR δ 1.45 (s, 9 H), 1.64-2.18 (m, 7 H), 2.45-2.84 (m, 6 H), 3.19-3.95 (m, 4 H), 6.01 (br s, 1 H), 7.13-7.26 (m, 3 H), 7.42 (d, J=7.7 H).

Step B.

1-(3-AMINOPROPYL) SPIRO[ISOCHROMAN-3,4'PIPERIDIN]-1-ONE:
To 1-(3-tert-Butoxycarbonylaminopropyl)spiro [isochroman-3,4'-piperidin]-1-one (0.144 g, 0.375 mmol) in 5 mL of dichloromethane, 1 mL of trifluoroacetic acid was added and the solution stirred at room temperature for 1 h. The solution was concentrated, neutralized with 10 % KOH solution and extracted into 25 mL of dichloromethane. The organic layer was dried over sodium sulfate, filtered and concentrated, giving 0.110 g (100%) of the product which was used as such for the subsequent step.

(±)-4-(3,4-BENZOFURAZAN)-6-METHYL-2-OXO-3-((SPIRO[ISOCHROMAN- 3,4'-PIPERIDIN]-1-ONE) PROPYL)-1,2,3,4-TETRAHYDROPYRIMIDINE-5- CARBOXYLIC ACID METHYL ESTER:
To (±)-4-(3,4-Benzofurazan)-1,6- dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)-carbonylpyrimidine (40.0 mg, 0.0865 mmol) in 10 mL of dry dichloromethane, spiro[isochroman-3,4'piperidin]-1-one (44.0 mg, 0.173 mmol) was added and the solution was stirred at room temperature for 24 h. The reaction

mixture was stirred for another 1 h after addition of 2 mL of 6N HCl. The reaction mixture was basified with 10% aqueous KOH solution (pH = 9) and extracted into dichloromethane (3 x 10 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving 50.0 mg (100%) of the desired product as a syrup: ¹H NMR δ 1.67-2.13 (m, 8 H), 2.45 (m, 5 H), 2.70 (t, J=7.4 Hz, 2 H), 2.72-2.75 (m, 2 H), 3.19 (t, J=7.4 Hz, 2 H), 3.34-3.45 (m, 2 H), 3.75 (s, 3 H), 6.82 (s, 1 H), 6.87 (s, 1 H), 7.13-7.44 (m, 3 H), 7.54 (d, J=9.6 Hz, 1 H), 7.43 (d, J=7.4 Hz, 1 H), 7.69 (s, 1 H), 7.79 (d, J=9.6 Hz, 1 H), 8.87 (t, J=5.2 Hz, 1 H).

To the free base (50.0 mg, 0.084 mmol) in 4 mL of dichloromethane, 5 mL of 1 N HCl in ether was added, and the solution concentrated under reduced pressure. Recrystallization from ether gave 30.0 mg (86 %) of the product as a white solid: m.p. 165-167 °C; Anal. Calcd. for C₂₁H₂₇N₃O₄Cl + 1.5 H₂O: C, 57.81; H, 5.95. Found: C, 57.75; H, 5.91.

Example 24

(1)-1,2,3,6-TETRAHYDRO-1-{N-[4-(3,4-DIHYDRO-2-OXOSPIRO-NAPHTHALENE-1(2H))-PIPERIDINE-1-YL]PROPYL}CARBOXAMIDO-5-METHOXY-CARBONYL-2- OXO-6-(3,4-DIFLUOROPHENYL)-4-METHYL-PYRIMIDINE

(±)-4-(3,4-DIFLUOROPHENYL)-6-METHYL-2-OXO-3-{(SPIRO[ISOCHEMOROMAN- 3,4'PIPERIDIN]-1-ONE)PROPYL}-1,2,3,4-TETRAHYDRO-PYRIMIDINE-5- CARBOXYLIC ACID METHYL ESTER: To (±)-4-(3,4-Difluorophenyl)- 1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophen-oxy)carbonyl-

pyrimidine (40.0 mg, 0.0865 mmol) in 10 mL of dry dichloromethane, spiro[isochroman-3,4'-piperidin]-1-one (44.0 mg, 0.173 mmol) was added and the solution was stirred at room temperature for 24 h. The reaction mixture was stirred for another 1 h after addition of 2 mL of 6N HCl. The reaction mixture was basified with 10% aqueous KOH solution (pH = 9) and extracted into dichloromethane (3 x 10 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving 45.0 mg (90%) of (\pm)-4-(3,4-difluorophenyl)-6-methyl-2-oxo-3-((spiro[isochroman-3,4'-piperidin]-1-one)propyl)-1,2,3,4-tetrahydropyrimidine-5-carboxylic acid methyl ester as a syrup;

¹H NMR δ 1.75-1.94 (m, 9H), 2.05-2.13 (m, 4 H), 2.36-2.41 (m, 5 H), 2.70 (t, J=7.35 Hz, 2 H), 2.77 (m, 2 H), 3.19 (t, J=7.4 Hz, 2 H), 3.39-3.43 (m, 2 H), 6.69 (s, 1 H), 7.04-7.45 (m, 8 H), 8.82 (t, J=5.2 Hz, 1 H).

To the free base (45.0 g, 0.077 mmol) in 4 mL of dichloromethane, 5 mL of 1 N HCl in ether was added, and the solution was concentrated *in vacuo*. Recrystallization from ether gave 0.050 g (100%) of (\pm)-4-(3,4-difluorophenyl)-6-methyl-2-oxo-3-((spiro[isochroman-3,4'-piperidin]-1-one)propyl)-1,2,3,4-tetrahydro-pyrimidine-5-carboxylic acid methyl ester hydrochloride as a white solid: m.p. 150-152 °C; Anal. Calcd. for C₃₁H₃₈F₂N₄OCl + 2 H₂O: C, 56.49; H, 5.96. Found: C, 56.40; H, 5.95.

Example 25

5-[(Z)-1-(1-ETHYL-2,2,4-TRIMETHYL-1,2-DIHYDRO-6-QUINOLINYL)-METHYLIDENE]-2-THIOXO-1,3-THIAZOLAN-4-ONE

Example 26

1-[BIS(4-FLUOROPHENYL)METHYL]-4-(3-PHENYL-2-PROPENYL)PIPERAZINE

5 **Example 27**

4-[(4-IMIDAZO[1,2-A]PYRIDIN-2-YLPHENYL)IMINO]METHYL-5-METHYL-1,3-BENZENEDIOL

Example 28

10 1-[3-(4-CHLOROBENZOYL)PROPYL]-4-BENZAMIDOPIPERIDINE

Preparation of

1-[3-(4-chlorobenzoyl)propyl]-4-benzamidopiperidine

15 1-[3-(4-CHLOROBENZOYL)PROPYL]-4-BENZAMIDOPIPERIDINE: A mixture of 3-(4-chlorobenzoyl)propyl bromide (640 mg, 2.45 mmol), 4-benzamidopiperidine (500 mg, 2.45 mmol) and K₂CO₃ (1.01 g, 7.34 mmol) in 50 ml of acetone was heated at reflux temperature for 48 h. The cooled reaction mixture was filtered to remove the solids, concentrated *in vacuo*, giving a yellow solid, which was purified by chromatography (MeOH/CHCl₃, 5/95). The product (320 mg, 33.9%) was isolated as a white powder: ¹H NMR δ 1.46 (dq, J₁=1.0 Hz, J₂=8.4 Hz, 2H), 1.90-2.10 (m, 4H), 2.16 (m, 2H), 2.43 (t, J=6.9 Hz, 2H), 2.80-2.90 (m, 2H), 2.97 (t, J=6.9 Hz, 2H), 3.97 (m, 1H), 5.92 (d, J=7.8 Hz, 1H, N-H), 7.40-8.00 (m, 9H). The product was converted to the HCl salt and recrystallized from MeOH/Et₂O, m.p. 243-244 °C; Anal. Calcd for C₂₂H₂₇ClN₂O₂ + HCl + H₂O: C, 60.15; H, 6.37; N, 6.37; Found: C, 60.18; H, 6.34; N, 6.29.

Example 29

4-[4-(4-CHLOROPHENYL)-4-HYDROXY-1-PIPERIDINYL]-1-(4-CHLOROPHENYL)-1-BUTANONE

Example 30

N-METHYL-8-[4-(4-FLUOROPHENYL)-4-OXOBUTYL]-1-PHENYL-1,3,8-
-TRI-AZASPIRO-[4.5]DECAN-4-ONE

5 **Example 31**

1H-1,2,3-BENZOTRIAZOL-1-YL (2-NITROPHENYL) SULFONE

Example 32

(1)-1,2,3,6-TETRAHYDRO-1-{N-[4-(DIHYDROINDENE)-1-YL]PROPYL}-
10 L}-
CARBOXAMIDO-5-METHOXYCARBONYL-2-OXO-6-(3,4-DIFLUORO)-4-ME-
THYL-PYRIMIDINE

1-(3-TERT-BUTOXYCARBONYLAMINOPROPYL)SPIRO[1H-INDANE-1,4'-
15 PIPERIDINE]: To a stirred solution of spiro[1H-indane-
1,4'-piperidine] (M.S.Chambers et al. *J. Med. Chem.*
(1992) 35, 2033.) (0.790 g, 4.22 mmol) in dioxane (20
mL), N-(tert-butoxy-carbonyl)-3-bromopropylamine (1.1 g,
4.64 mmol) and potassium carbonate (1.17 g, 8.44 mmol)
20 were added and the resulting solution was heated at
reflux temperature for 24 h. The reaction mixture was
cooled to room temperature, concentrated and partitioned
between 40 mL of chloroform and 5 mL of water. The
organic layer was dried over sodium sulfate, filtered and
25 concentrated. The crude product was purified by column
chromatography (ethyl acetate/ methanol, 4.5/0.5) to
yield 0.886 g (61 %) of the required product as a
colorless oil: ¹H NMR δ 1.46 (s, 9 H), 1.55 (d, J=11.3 Hz,
2 H), 1.69 (t, J=6.3 Hz, 2 H), 1.88-2.47 (m, 6 H), 2.47
30 (t, J=6.3 Hz, 2 H), 2.88 (t, J=3.3 Hz, 4 H), 3.23 (d,
J=5.6 Hz, 2 H), 5.85 (br s, 1 H), 7.18 (s, 4 H).

1-(3-AMINOPROPYL)SPIRO[1H-INDANE-1,4'-PIPERIDINE]: To
1-(3-tert- Butoxycarbonylaminopropyl)spiro[1H-indane-

1,4'-piperidine] (0.180 g, 0.52 mmol) in 5 mL of dichloromethane, 1 mL of trifluoroacetic acid was added and the solution stirred at room temperature for 1 h. The solution was concentrated, neutralized with 10 % KOH solution and extracted into 25 mL of dichloromethane. The organic layer was dried over sodium sulfate, filtered and concentrated, giving 0.156 g (100%) of the product which was used as such for the subsequent step.

(±)-4-(3,4-DIFLUORO)-6-METHYL-2-OXO-3-{SPIRO[1H-INDANE-1, 4'-PIPERIDINE]PROPYL}-1,2,3,4-TETRAHYDOPYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER: To (±)-4-(3,4-difluoro)-1,6-dihydro-2-methoxy-5-methoxycarbonyl-4-methyl-1-(4-nitrophenoxy)carbonylpyrimidine (50.0 g, 0.108 mmol) in 10 mL of dry dichloromethane, 1-(3-aminopropyl) spiro[1H-indane-1,4'-piperidine] (53.0 mg, 0.216 mmol) was added and the solution was stirred at room temperature for 24 h. The reaction mixture was stirred for another 1 h after addition of 2 mL of 6N HCl. The reaction mixture was basified with 10% aqueous KOH solution (pH = 9) and extracted into dichloromethane (3 x 10 mL). The organic layer was dried over sodium sulfate, filtered and concentrated. The crude product was purified by flash chromatography (EtOAc/ MeOH, 4.5/0.5), giving 60.0 mg (100%) of the product as a syrup: ¹H NMR δ 1.52 (d, J=13.2 Hz, 2 H), 1.70-2.07 (m, 8 H), 2.12 (t, J=10.3 Hz, 2 H), 2.42 (s, 4 H), 2.86-2.91 (m, 3 H), 3.32-3.43 (m, 2 H), 3.72 (s, 3 H), 6.71 (s, 1 H), 6.81 (br s, 1 H), 7.04-7.19 (m, 7 H), 8.82 (t, J=5.2 Hz, 1 H).

To the free base (0.060 g, 0.108 mmol) in 4 mL of dichloromethane, 5 mL of 1 N HCl in ether was added, and the solution was concentrated under reduced pressure. Recrystallization from ether gave 0.070 g (100%) of the product as a white solid; m.p. 150-153 °C; Anal. Calcd.

for $C_{14}H_{12}F_2N_4O_4Cl$: C, 54.86; H, 5.53; N, 8.54. Found: C, 54.96; H, 5.57; N, 8.27.

5 **Example 33**

(+)-1,2,3,6-TETRAHYDRO-1-{N-[4-(3,4,5-TRIFLUORO)-PHENYL-PIPERIDIN-1-YL]PROPYL}CARBOXAMIDO-4-METHOXYMETHYL-6-(3,4-DIFLUOROPHENYL)-2-OXOPYRIMIDINE-5-CARBOXYLIC ACID METHYL ESTER: mp °C; $[\alpha]_D^{25} = +123.0$, (c = 0.15, MeOH); 1H NMR δ 1.70-1.82 (m, 6H), 1.97-2.08 (m, 2H), 2.40 (t, J=6.9 Hz, 2H), 2.74-2.87 (m, 1H), 3.01 (d, J=11.1 Hz, 2H), 3.29-3.40 (m, 2H), 3.49 (s, 3H), 3.71 (s, 3H), 4.69 (s, 2H), 6.68 (s, 1H), 6.88-6.95 (m, 2H), 7.05-7.11 (m, 2H), 7.15-7.22 (m, 1H), 7.71 (s, 1H), 8.90 (t, J=5.4 Hz, 1H).

15

Example 34

(+)-1,2,3,6-TETRAHYDRO-1-{N-[2-(S)-METHYL]-4-(2-NITROPHENYL)-PIPERAZIN-1-YL]PROPYL}-CARBOXAMIDO-4-METHYL-6-(3,4-DIFLUOROPHENYL)-2-EXO-PYRIMIDINE

20

(S)-(+)-3-METHYL-1-(2-NITROPHENYL)-PIPERAZINE: To a solution of 2-bromonitrobenzene (0.600 g, 3.00 mmol) in 1,4-dioxane (15 mL) was added (S)-(+)-2-methylpiperazine (0.500 g, 0.500 mmol) and powdered K_2CO_3 (15.0 mmol, 1.50 g) and the resulting suspension was heated at reflux for 10 h. After the suspension was cooled, it was filtered through a sintered glass funnel and the solvent was removed *in vacuo*. The resulting residue was purified by column chromatography (1/1 hexane/EtOAc followed by 4/1 EtOAc/MeOH), giving (S)-(+)-3-methyl-1-(2-nitrophenyl)-piperazine as an orange oil (0.53 g, 80%).

30

(+)-1,2,3,6-TETRAHYDRO-1-{N-[2-(S)-METHYL]-4-(2-NITROPHEN

YL) PIPERAZIN-1YL] PROPYL)-CARBOXAMIDO-4-METHYL-6-(3,4-DIFLUOROPHENYL)-2-OXO-PYRIMIDINE: To a solution of (+)-1-(3-bromo-propylcarbamoyl)-6-(3,4-difluorophenyl)-4-methyl-2-oxo-1,6-dihydro-pyrimidine-5-carboxylic acid methyl ester (0.200 g, 0.500 mmol) and (S)-(+)-3-methyl-1-(2-nitrophenyl)-piperazine (0.170 g, 0.750 mmol) in 20 mL of anhydrous acetone was added powdered K_2CO_3 (0.34 g, 3.5 mmol) and KI (0.07 g, 0.5 mmol) and the resulting suspension was heated at reflux temperature for 10 h. TLC indicated a new spot for the product (R_f = 0.3, 3/0.5 EtOAc/MeOH) and mostly the starting material. The suspension was cooled, filtered and the solvent was evaporated and the residue was purified by column chromatography (EtOAc/MeOH, 5/1). (+)-1,2,3,6-Tetrahydro-1-{N-[2-(S)-methyl]-4-(2-nitrophenyl)piperazin-1-yl]-propyl}-carboxamido-4-methyl-6-(3,4-difluorophenyl)-2-oxo-pyrimidine was obtained as yellow oil (0.030 g, 10% yield). The HCl salt was prepared by the addition of HCl in ether to a solution of the product in dichloromethane, followed by evaporation of the solvents; mp 150-153 °C; $[\alpha]_D^{25} = 58.3$ (c = 0.3, MeOH); 1H NMR (CD₃OD) δ 1.04 (d, J=6.0 Hz, 3 H), 1.71-1.78 (m, 2 H), 2.33-2.49 (m, 3 H), 2.42 (s, 3 H), 2.55-2.92 (m, 5 H), 3.00-3.10 (m, 3 H), 3.34-3.42 (m, 2 H), 3.72 (s, 3 H), 6.71 (s, 1 H), 7.01-7.32 (m, 6 H), 7.46 (dt, J=0.7 Hz, J=8.4 Hz, 1 H), 7.74 (dd, J=1.5, 8.4 Hz, 1 H), 8.82 (t, J=3.9 Hz, 1 H). Anal calcd. for $C_{21}H_{23}N_6F_2O_6 + 0.20 CH_2Cl_2$: C, 52.92; H, 5.26; N, 13.13. Found: C, 52.84; H, 5.68; N, 12.94.

Example 35

1,2,3,6-TETRAHYDRO-1{N-[4-(2'-METHYL-PHENYL) PIPERAZIN-1-YL]-PROPYL}-CARBOXAMIDO-4-METHYL-6-(3,4-DIFLUOROPHENYL)-2-OXO-PYRIMIDINE: The amine used was

4-(2'-methyl-phenyl)piperazine. ^1H NMR δ 1.75-1.80 (m, 2 H), 2.29 (s, 3 H), 2.42 (s, 3 H), 2.41-2.48 (m, 2 H), 2.58-2.62 (m, 4 H), 2.91-2.97 (m, 4 H), 3.35-3.42 (m, 2 H), 3.72 (s, 3 H), 6.71 (s, 1 H), 6.97-7.26 (m, 8 H), 8.81 (t, $J=3.9$ Hz, 1 H). The product was dissolved in ether and 1 N HCl in ether was added. The ether was evaporated, giving the dihydrochloride salt; mp 66-71 C. Anal calcd. for $\text{C}_{22}\text{H}_{25}\text{N}_5\text{F}_2\text{O}_4 \cdot \text{Cl}_2 + 1.75$ acetone: C, 55.73; H, 6.40; N, 9.78. Found: C, 56.16; H, 6.29; N, 10.06.

10

Example 36

(+)-1,2,3,6-TETRAHYDRO-5-METHOXYCARBONYL-4-METHOXYMETHYL-2-OXO-1-{N-[3-(4-METHYL-4-PHENYL PIPERIDINE-1-YL)PROPYL]}-6-(3,4-DIFLUOROPHENYL) PYRIMIDINE: Hygroscopic; $[\alpha]_D^{25} = +82.1$ (c = 0.31, MeOH); ^1H NMR δ 1.14 (s, 3 H), 1.61-1.72 (m, 4 H), 2.03-2.08 (m, 2 H), 2.25 (t, $J=7.2$ Hz, 2 H), 2.30-2.42 (m, 4 H), 3.19-3.31 (m, 2 H), 3.40 (s, 3 H), 3.63 (s, 3 H), 4.60 (s, 2 H), 6.60 (s, 1 H), 6.97-7.29 (m, 8 H), 7.63 (br s, 1 H), 8.78 (t, $J=5.7$ Hz, 1 H). Anal calcd. for $\text{C}_{30}\text{H}_{37}\text{N}_4\text{O}_5\text{F}_2\text{Cl} + \text{CH}_2\text{Cl}_2$: C, 53.80; H, 5.68; N, 8.10. Found: C, 53.79; H, 6.03; N, 7.83.

15

20

EXAMPLE 37

5-(5-BUTYL-2-THIENYL) PYRIDO[2,3-d]PYRIMIDINE-2,4,7(1H,3H,8H)-TRIONE

25

General Procedure for the reaction of pyrimidine-3-carboxylic acid-4-nitrophenyl esters with amines:

A solution of substituted pyrimidine-3-carboxylic acid-4-nitrophenyl ester (0.29 mmol) and a substituted 4-phenyl-1-(3-propylaminopiperidine (0.30 mmol) in 10 mL of anhydrous THF was stirred overnight at room temperature. The solvent was removed *in vacuo* and the residue was purified by column chromatography.

10 **Example 38**

METHYL (4S)-3-[(3-[4-(3-AMINOPHENYL)-1-PIPERIDINYL]PROPYL)AMINO)CARBONYL]-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: ¹H NMR (400 MHz, CDCl₃) δ 7.80 (s, 1H), 7.22-7.02 (m, 2H), 6.95 (t, 2H, J=8.7 Hz), 6.63-6.44 (m, 4H), 4.56 (ABq, 2H), 3.62 (s, 3H), 3.33 (s, 3H), 3.32 (m, 4H), 2.96 (br s, 2H), 2.34 (t, 2H, J=7.5 Hz), 2.11-1.94 (m, 3H), 1.81-1.64 (m, 4H); ESMS m/e: 572.3 (M + H)⁺.

20

Example 39

The product was obtained according to the method described for Example 40.

25 METHYL (4S)-4-(3,4-DIFLUOROPHENYL)-3-([3-(4-{3-[(METHOXYACETYL)AMINO]PHENYL}-1-PIPERIDINYL)PROPYL]AMINO)CARBONYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: 15.6 mg (69% yield); ¹H NMR (400 MHz, CDCl₃) δ 9.01 (s, 1H), 8.25 (s, 1H), 7.60 (s, 1H), 7.37 (d, 1H, J=7.2 Hz), 7.30-7.05 (m, 5H), 7.02 (d, 1H, J=8.0 Hz), 6.71 (s, 1H), 4.70 (s, 2H), 4.03 (s, 2H), 3.73 (s, 3H), 3.53 (s, 3H), 3.47 (s, 3H), 3.42-3.33 (m, 2H), 3.08 (br s, 2H), 2.49 (br s,

30

2H), 2.20 (s, 2H), 2.07 (br s, 1H), 1.97-1.75 (m, 4H);
ESMS m/e: 644.3 (M + H)⁺

Example 40

5 METHYL (4S)-4-(3,4-DIFLUOROPHENYL)-3-([3-(4-{3-[(3,3-DIMETHYLBUTANOYL)AMINO]PHENYL}-1-PIPERIDINYL)PROPYL]AMINO)CARBONYL)-6-(METHOXYMETHYL)-2-
OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXYLATE

10 To the 20 ml vial was added methyl (4S)-3-([3-[4-(3-aminophenyl)-1-piperidinyl]propyl]amino)carbonyl]-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate (0.035 mmol), an acid
chloride or sulfonyl chloride (1.5 eq), N,N-
15 diisopropylethylamine (5 eq) and dichloromethane (2 ml) at room temperature. The reaction mixture was stirred at room temperature for 24 h, at which time the TLC
analysis indicated the reaction was completed. The reaction mixture was concentrated to a small volume and
20 purified by preparative TLC (silica, 2000 microns, 95:5 = dichloromethane : methanol with 1% of isopropylamine) to give 5.6 mg of methyl (4S)-4-(3,4-difluorophenyl)-3-([3-(4-{3-[(3,3-dimethylbutanoyl)amino]phenyl}-1-piperidinyl)propyl]amino)carbonyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate: 24.6%
25 yield; ¹H NMR (400 MHz, CDCl₃) δ 7.50 (s, 1H), 7.26 (d, 1H, J=8.3 Hz), 7.15-7.02 (m, 5H), 6.88 (d, 1H, J=8.3 Hz), 6.55 (s, 1H), 4.56 (ABq, 2H), 3.62 (s, 3H), 3.32 (s, 3H), 3.25 (t, 4H, J=9.0 Hz), 2.99 (d, 2H, J=10.8 Hz),
30 2.49-2.37 (m, 3H), 2.08 (t, 2H, J=11.7 Hz), 1.78-1.65 (m, 14H); ESMS m/e: 670.4 (M + H)⁺.

Example 41

The product was obtained according to the method described for methyl (4S)-4-(3,4-difluorophenyl)-3-({[3-(4-{3-[(3,3-dimethylbutanoyl)amino]phenyl}-1-piperidinyl)propyl]amino}carbonyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate.

METHYL (4S)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-
OXO-3-{{[3-(4-{3-(PROPIONYLAMINO)PHENYL}-1-
PIPERIDINYL)PROPYL]AMINO}CARBONYL}-1,2,3,4-TETRAHYDRO-5-
PYRIMIDINECARBOXYLATE: 9.9 mg (45% yield) δ ^1H NMR (400
MHz, CDCl_3) δ 7.36 (s, 1H), 7.28 (d, 1H, $J=8.0$ Hz), 7.16-
7.02 (m, 5H), 6.86 (d, 1H, $J=7.6$ Hz), 6.54 (s, 1H), 4.56
(ABq, 2H), 3.62 (s, 3H), 3.32 (s, 3H), 3.27-3.19 (m,
4H), 2.95 (d, 2H, $J=10.3$ Hz), 2.41 (m, 1H), 2.34 (t, 2H,
 $J=7.7$ Hz), 2.28 (q, 2H, $J=7.6$ Hz), 2.01 (t, 2H, $J=11.1$
Hz), 1.73-1.64 (m, 8H); ESMS m/e : 628.4 ($M + H$) $^+$

Example 42

The product was obtained according to the method described for methyl (4S)-4-(3,4-difluorophenyl)-3-({[3-(4-{3-[(3,3-dimethylbutanoyl)amino]phenyl}-1-piperidinyl)propyl]amino}carbonyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate.

METHYL (4S)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-3-
({[3-(4-{3-[(3-METHYLBUTANOYL)AMINO]PHENYL}-1-
PIPERIDINYL)PROPYL]AMINO}CARBONYL)-2-OXO-1,2,3,4-
TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: 10.4 mg (45% yield)
 δ ^1H NMR (400 MHz, CDCl_3) δ 7.36 (s, 1H), 7.28 (d, 1H,
 $J=7.9$ Hz), 7.16-7.03 (m, 5H), 6.88 (d, 1H, $J=7.4$ Hz),
6.56 (s, 1H), 4.56 (ABq, 2H), 3.62 (s, 3H), 3.32 (s,
3H), 3.25 (t, 4H, $J=6.7$ Hz), 2.98 (d, 2H, $J=11.1$ Hz),

2.43 (m, 1H), 2.38 (t, 2H, J=7.5 Hz), 1.13 (d, 2H, J=7.5 Hz), 2.10-2.01 (m, 2H), 1.75-1.64 (m, 6H), 0.91 (d, 6H, J=5.8 Hz); ESMS m/e: 656.4 (M + H)⁺

5 **Example 43**

The product was obtained according to the method described for methyl (4S)-4-(3,4-difluorophenyl)-3-([3-(4-{3-[(3,3-dimethylbutanoyl)amino]phenyl}-1-piperidinyl)propyl]amino)carbonyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate.

METHYL (4S)-4-(3,4-DIFLUOROPHENYL)-3-{[(3-{4-[3-(ISOBUTYRYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)AMINO]CARBONYL}-6-(METHOXYMETHYL)-2-
 15 OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: 16.4 mg (73% yield) δ ¹H NMR (400 MHz, CDCl₃) δ 7.37 (s, 1H), 7.28 (d, 1H, J=7.3 Hz), 7.16-7.01 (m, 5H), 6.88 (d, 2H, J=7.3 Hz), 6.54 (s, 1H), 4.56 (ABq, 2H), 3.62 (s, 3H), 3.32 (s, 3H), 3.25 (t, 2H, J=6.8 Hz), 3.23-3.18 (m, 2H), 3.03
 20 (d, 2H, J=11.7 Hz), 2.57-2.48 (m, 1H), 2.43 (t, 2H, J=8.0 Hz), 2.14 (t, 2H, J=9.4 Hz), 1.8-1.65 (m, 5H), 1.09 (d, 6H, J=6.3 Hz); ESMS m/e: 642.4 (M + H)⁺

Example 44

25 The product was obtained according to the method described for methyl (4S)-4-(3,4-difluorophenyl)-3-([3-(4-{3-[(3,3-dimethylbutanoyl)amino]phenyl}-1-piperidinyl)propyl]amino)carbonyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylate.

30 METHYL (4S)-3-{[(3-{4-[3-(BUTYRYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)AMINO]CARBONYL}-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-

TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: 14.7 mg (65.5%
 yield) δ ^1H NMR (400 MHz, CDCl_3) δ 7.38 (s, 1H), 7.26 (s,
 1H), 7.17-6.99 (m, 5H), 6.87 (s, 1H), 6.55 (s, 1H), 4.56
 (ABq, 2H), 3.63 (s, 3H), 3.33 (s, 3H), 3.28-3.17 (m,
 5 6H), 3.0 (br s, 2H), 2.51-2.36 (m, 3H), 2.25 (t, 2H,
 $J=5.0$ Hz), 2.10 (br s, 2H), 1.8-1.56 (m, 6H), 0.90 (t,
 3H, $J=5.0$ Hz); ESMS m/e : 642.4 ($M + H$) $^+$.

Example 45

10 (4R)-N-(3-{4-[3-(BUTYRYLAMINO)PHENYL]-1-
 PIPERIDINYL}PROPYL)-4-(3,4-DIFLUOROPHENYL)-6-
 (METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-
 PYRIMIDINECARBOXAMIDE

15 Method:

**(4R)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-
 1,2,3,4-tetrahydro-5-pyrimidinecarboxylic acid:** A

20 stirred mixture of one mole equivalent of methyl (4R)-4-
 (3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-
 tetrahydro-5-pyrimidinecarboxylate (10.0 g, 32.0 mmol)
 and lithium hydroxide (2 equivalents, 1.53 g, 64.0 mol)
 in H_2O -THF (2:1, 300 mL) was heated at reflux temperature
 for 1 h. The reaction mixture was concentrated,
 25 dissolved in water, washed with ethyl acetate and
 acidified (1 N HCl) to pH 3-4 (pH paper). The
 precipitated product was collected, washed with water
 and dried under reduced pressure to give the desired
 product in 90% yield.

30

**(4R)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-N-[3-(4-
 (3-NITROPHENYL)-3,6-DIHYDRO-1(2H)-PYRIDINYL)PROPYL]-2-
 OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE:** A

solution of (4R)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxylic acid (1.2 eq), EDC (1.5 Eq.), N-methylmorpholine (2.0 Eq.) in dichloromethane was stirred at room temperature for 15 minutes, followed by addition of 3-(4-(3-nitrophenyl)-3,6-dihydro-1(2H)-pyridinyl)-1-propanamine (1.0 eq.) to the reaction mixture. The resulting solution was stirred for 18 hours, concentrated and chromatographed on silica to give (4R)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-N-[3-(4-(3-nitrophenyl)-3,6-dihydro-1(2H)-pyridinyl)propyl]-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

(4R)-N-{3-[4-(3-AMINOPHENYL)-1-PIPERIDINYL] PROPYL}-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-

TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE: A mixture of (4R)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-N-[3-(4-(3-nitrophenyl)-3,6-dihydro-1(2H)-pyridinyl)propyl]-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide, 10% Pd/C in ethanol was hydrogenated (balloon method) for 2 days. The reaction mixture was filtered through Celite 545, washed with ethanol and concentrated to give the desired product.

(4R)-N-(3-{4-[3-(BUTYRYLAMINO) PHENYL]-1-PIPERIDINYL} PROPYL)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-

PYRIMIDINECARBOXAMIDE: Into a 20 mL vial was added (4R)-N-[3-[4-(3-aminophenyl)-1-piperidinyl]propyl]-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide (0.040 mmol), acid chloride (1.5 eq) and N,N-diisopropylethylamine (5.0 eq) in 2.0 mL of dichloromethane at room temperature. After

24 hrs, the reaction mixture was concentrated *in vacuo* and purified by preparative TLC (silica, 2000 microns, 95:5 = dichloromethane : methanol with 1% of isopropylamine) to give 9.2 mg (45% yield) of the
 5 desired product: ^1H NMR (400 MHz, CD_3OD) δ 7.49 (s, 1H), 7.25 (d, 1H, $J=7.6$ Hz), 7.20-7.02 (m, 5H), 6.91 (d, 1H, $J=8$ Hz), 5.29 (s, 1H), 4.24 (ABq, 2H), 3.30 and 3.24 (two s, 3H), 3.46-3.12 (m, partially hidden by three s, 4H), 2.74 (br s, 4H), 2.25 (t, 2H, $J=8.2$ Hz), 2.04-1.69
 10 (m, 7H), 1.63 (sextet, 2H, $J=7.4$ Hz), 0.91 (t, 3H, 7.4 Hz); ESMS m/e : 584.4 ($M + H$) $^+$.

Example 46

The product was obtained according to the method
 15 described for (4R)-N-(3-{4-[3-(butyrylamino)phenyl]-1-piperidinyl}propyl)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

20 (4R)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-2-OXO-N-(3-{4-[3-(PROPIONYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE: 5.6 mg (24.6% yield); ^1H NMR (400 MHz, CD_3OD) δ 7.56 (s, 1H), 7.35 (d, 1H, $J=6.9$ Hz), 7.3-7.03 (m, 4H), 7.17 (br s, 1H), 6.99 (d, 1H, $J=7.0$ Hz), 5.45 (s, 1H), 4.33 (ABq, 2H), 3.41 (s, 3H), 3.37-3.23 (m, partially hidden, 4H),
 25 2.8 (br s, 4H), 2.39 (d, 2H, $J=9.3$ Hz), 2.14-1.78 (m, 7H), 1.21 (t, 3H, $J=7.6$ Hz); ESMS m/e : 570.4 ($M + H$) $^+$.

Example 47

The product was obtained according to the method described for (4R)-N-(3-{4-[3-(butyrylamino)phenyl]-1-piperidinyl}propyl)-4-(3,4-difluorophenyl)-6-

(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

(4R)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-N-[3-(4-
 5 {3-[(3-METHYLBUTANOYL)AMINO]PHENYL}-1-PIPERIDINYL)PROPYL]-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE: 11.1 mg (46% yield); ¹H NMR (400 MHz, CD₃OD) δ 7.81 (d, 1H, J=8.5 Hz), 7.6 (s, 1H), 7.55 (s, 1H), 7.36 (br s, 1H), 7.31-7.17 (m, 3H), 7.01 (t, 1H, J=6.7 Hz) 6.64-6.61 (m, 1H), 5.45 (br s, 1H), 4.32 (ABq, 2H), 3.94 and 3.87 (two s, 3H), 3.42-3.12 (m, partially
 10 hidden, 2H), 3.1 (br s, 2H), 3.0 (t, 2H, J=11.1 Hz), 2.79-2.57 (m, 4H), 2.27-1.73 (m, 8H), 1.19 and 1.01 (two d, 6H, J=6.6 Hz); ESMS m/e: 598.4 (M + H)⁺.

15

Example 48

The product was obtained according to the method described for (4R)-N-(3-{4-[3-(butyrylamino)phenyl]-1-piperidinyl}propyl)-4-(3,4-difluorophenyl)-6-
 20 (methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

(4R)-4-(3,4-DIFLUOROPHENYL)-6-(METHOXYMETHYL)-N-[3-(4-
 {3-[(2-METHYLBUTANOYL)AMINO]PHENYL}-1-PIPERIDINYL)PROPYL]-2-OXO-1,2,3,4-TETRAHYDRO-5-
 25 PYRIMIDINECARBOXAMIDE: 6.7 mg (28% yield); ¹H NMR (400 MHz, CD₃OD) δ 7.59 (s, 1H), 7.35 (br s, 1H), 7.3-7.2 (m, 3H), 7.17 (br s, 1H), 7.01 (d, 1H, J=6.8 Hz), 5.45 (s, 1H), 4.33 (ABq, 2H), 3.39 (s, 3H), 3.29 (m, 2H), 2.84
 30 (br s, 4H), 2.42 (m, 1H), 2.14-1.78 (m, 9H), 1.7 (m, 1H), 1.49 (m, 1H), 1.20 (d, 3H, J=6.7 Hz), 0.95 (t, 3H, J=6.6 Hz); ESMS m/e: 598.4 (M + H)⁺.

Example 49

The product was obtained according to the method described for (4R)-N-(3-{4-[3-(butyrylamino)phenyl]-1-piperidinyl}propyl)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

(4R)-4-(3,4-DIFLUOROPHENYL)-N-[3-(4-{3-[(3,3-DIMETHYLBUTANOYL)AMINO]PHENYL}-1-PIPERIDINYL)PROPYL]-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE: 1.1 mg (4.4% yield); ¹H NMR (400 MHz, CD₃OD) δ 7.6-6.91 (m, 7H), 5.43 (s, 1H), 4.31 (ABq, 2H), 3.40 (s, 3H), 3.27-1.26 (m, 17 H), 1.09 (s, 9H); ESMS m/e: 612.4 (M + H)⁺.

Example 50

The product was obtained according to the method described for (4R)-N-(3-{4-[3-(butyrylamino)phenyl]-1-piperidinyl}propyl)-4-(3,4-difluorophenyl)-6-(methoxymethyl)-2-oxo-1,2,3,4-tetrahydro-5-pyrimidinecarboxamide.

(4R)-4-(3,4-DIFLUOROPHENYL)-N-(3-{4-[3-(ISOBUTYRYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)-6-(METHOXYMETHYL)-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXAMIDE: 12.7 mg (54% yield); ¹H NMR (400 MHz, CD₃OD) δ 7.59 (s, 1H), 7.36 (d, 1H, J=8.6 Hz), 7.31-7.07 (m, 4H), 7.01 (d, 1H, J=6.5 Hz), 5.39 (s, 1H), 4.34 (ABq, 2H), 3.35 (s, 3H), 3.33-3.19 (m, partially hidden, 2H), 3.08-2.72 (m, 4H), 2.63 (t, 2H, J=7.2 Hz), 2.14-1.82 (m, 8H), 1.19 (d, 6H, J=6.9 Hz); ESMS m/e: 584.4 (M + H)⁺.

Example 51

The synthetic method is the same as described for the synthesis of (4S)-N-(3-{4-[3-(acetylamino)phenyl]-1-piperidinyl}propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-oxazolidine-3-carboxamide.

5-ACETYL-N-(3-{4-[3-(ACETYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)-4-METHYL-2-OXO-6-(3,4,5-TRIFLUOROPHENYL)-3,6-DIHYDRO-1(2H)-PYRIMIDINECARBOXAMIDE: 14.5 mg (46% yield); ¹H NMR (400 MHz, CDCl₃) δ 9.56 (s, 1H), 9.20 (s, 1H), 8.21 (s, 1H), 7.52 (s, 1H), 7.18 (t, 1H, J=7.8 Hz), 7.07-6.75 (m, 5H), 3.59-3.37 (m, 1H), 3.48-3.38 (m, 1H), 3.08 (br s, 2H), 2.57-2.39 (m, 5H), 2.25 (s, 3H), 2.21 (s, 3H), 2.19-1.59 (m, 9H); ESMS m/e: 586.3 (M + H)⁺; Anal. Calc. for C₃₀H₃₄F₃N₅O₄+0.1CHCl₃: C, 60.50; H, 5.75; N, 11.72. Found: C, 60.59; H, 5.40; N, 11.73.

Example 52

The synthetic method is the same as described for the synthesis of (4S)-N-(3-{4-[3-(acetylamino)phenyl]-1-piperidinyl}propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-oxazolidine-3-carboxamide.

BENZYL 3-[[3-(4-[3-(ACETYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)AMINO]CARBONYL-4-(2,4-DIFLUOROPHENYL)-6-ETHYL-2-OXO-1,2,3,4-TETRAHYDRO-5-PYRIMIDINECARBOXYLATE: 14.8 mg (41% yield); ¹H NMR (400 MHz, CDCl₃) δ 9.05 (br s, 1H), 8.14 (s, 1H), 7.47 (s, 1H), 7.37-7.21 (m, 8H), 7.18 (t, 1H, J=7.7 Hz), 6.94 (d, 1H, J=6.9 Hz), 6.87 (d, 1H, J=7.4 Hz), 6.7-6.62 (m, 3H), 5.09 (q, 2H, J=17.8 Hz), 3.48-3.24 (m, 2H), 3.04 (ABq, 2H), 2.88-2.71 (m, 2H), 2.52-2.39 (m, 2H), 2.19 (s, 3H),

2.17-1.88 (m, 3H), 1.77-1.58 (m, 3H), 1.19 (t, 3H, $J=7.5$ Hz); ESMS m/e : 674.4 ($M + H$)⁺.

Example 53

5 The synthetic method is the same as described for the synthesis of (4S)-N-(3-{4-[3-(acetylamino)phenyl]-1-piperidinyl}propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-oxazolidine-3-carboxamide.

10 N-(3-{4-[3-(ACETYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL)-4-(1,3-BENZODIOXOL-5-YL)-2,5-DIOXO-1,2,5,7-TETRAHYDROFURO[3,4-D]PYRIMIDINE-3(4H)-CARBOXAMIDE: 8.75 mg (28% yield); ¹H NMR (400 MHz, CDCl₃) δ 9.81 (s, 1H), 8.14 (s, 1H), 7.53 (s, 1H), 7.21 (t, 1H, $J=7.7$ Hz), 6.99 (d, 1H, $J=7.7$ Hz), 6.91-6.7 (m, 4H), 6.42 (s, 1H), 5.9 (s, 2H), 4.75 (s, 2H), 3.61-3.5 (m, 1H), 3.37-3.27 (m, 1H), 3.08 (br s, 2H), 2.56-2.40 (m, 3H), 2.18 (s, 3H), 2.16-1.85 (m, 4H), 1.78-1.6 (m, 5H); ESMS m/e : 576.3 ($M + H$)⁺.

20

Example 54

The synthetic method is the same as described for the synthesis of (4S)-N-(3-{4-[3-(acetylamino)phenyl]-1-piperidinyl}propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-oxazolidine-3-carboxamide.

25

METHYL 1-{{{3-{4-[3-(ACETYLAMINO)PHENYL]-1-PIPERIDINYL}PROPYL}AMINO}CARBONYL}-2-[(4-METHOXYBENZYL)SULFANYL]-4-METHYL-6-(4-NITROPHENYL)-1,6-DIHYDRO-5-PYRIMIDINECARBOXYLATE: 10.1 mg (26% yield); ¹H NMR (400 MHz, CDCl₃) δ 8.02 (d, 2H, $J=7.5$ Hz), 7.53 (br s, 1H), 7.44-7.27 (m, 6H), 7.14 (d, 2H, $J=8.5$ Hz), 6.99 (d, 1H, $J=7.6$ Hz), 6.75 (d, 2H, $J=8.5$ Hz), 6.2 (s, 1H), 4.23

30

(ABq, 2H), 3.78 (s, 3H), 3.7 (s, 3H), 3.58-3.48 (m, 1H;
 3.37-3.26 (m, 2H), 3.04 (m, 2H), 2.61-2.43 (m, 3H), 2.41
 (s, 3H), 2.16 (s, 3H), 2.15-1.64 (m, 8H); ESMS m/e:
 729.3 (M + H)⁺.

5

Example 55

The synthetic method is the same as described for the
 synthesis of (4S)-N-(3-(4-[3-(acetylamino)phenyl]-1-
 piperidinyl)propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-
 10 oxazolidine-3-carboxamide.

N-(3-(4-[3-(ACETYLAMINO)PHENYL]-1-PIPERIDINYL)PROPYL)-4-
 (2,1,3-BENZOXADIAZOL-5-YL)-2,5-DIOXO-1,2,5,7-
 TETRAHYDROFURO[3,4-D]PYRIMIDINE-3(4H)-CARBOXAMIDE: 7.7
 15 mg (12% yield); ¹H NMR (400 MHz, CDCl₃) δ 7.97-6.83 (m,
 7H), 6.49 (s, 1H), 5.51 (s, 1H), 3.43-2.02 (m, 17 H),
 1.92 (s, 3H); ESMS m/e: 574.3 (M + H)⁺.

Example 56

20 The synthetic method is the same as described for the
 synthesis of (4S)-N-(3-(4-[3-(acetylamino)phenyl]-1-
 piperidinyl)propyl)-4-(3,5-difluorophenyl)-2-oxo-1,3-
 oxazolidine-3-carboxamide.

25 METHYL (4S)-3-([(3-(4-[3-(ACETYLAMINO)PHENYL]-1-
 PIPERIDINYL)PROPYL)AMINO]CARBONYL)-4-(3,4-
 DIFLUOROPHENYL)-6-METHYL-2-OXO-1,2,3,4-TETRAHYDRO-5-
 PYRIMIDINECARBOXYLATE: 16.6 mg (52% yield); ¹H NMR (400
 30 MHz, CDCl₃) δ 9.55 (br s, 1H), 9.07 (s, 1H), 8.19 (s,
 1H), 7.54 (s, 1H), 7.25-6.98 (m, 4H), 6.95 (d, 1H, J=8.0
 Hz), 6.81 (d, 1H, J=7.5 Hz), 6.69 (s, 1H), 3.70 (s, 3H),
 3.57-3.34 (m, 2H), 3.06 (t, 2H, J=11.6 Hz), 2.47 (t, 2H,
 J=8.1 Hz), 2.42 (s, 3H), 2.20 (s, 3H), 2.18-1.61 (m,

9H); ESMS m/e : 584.3 ($M + H$)⁺; Anal. Calc. for

$C_{23}H_{35}F_2N_5O + 0.25CHCl_3$: C, 59.23; H, 5.79; N, 11.42. Found:

C, 59.61; H, 5.31; N, 11.48.

Peptide Synthesis:

Abbreviations: Fmoc: 9-Fluorenyloxycarbonyl-; Trityl:
5 triphenylmethyl-; tBu-: tertiary butyl ester; OtBu-:
tertiary butyl ether; Ng: N-guanidinyll; Nin: N-Indole;
MBHA : methylbenzhydlamine; DMF: N,N-dimethylformamide;
NMP: N-Methylpyrrolidinone; DIEA: diisopriplethyl
amine; TFA: trifluoroacetic acid.

10

Small scale peptide syntheses were performed either
manually, by using a sintered glass column with argon
pressure to remove solvents and reagents, or by using an
Advanced ChemTech 396-9000 automated peptide synthesizer
15 (Advanced ChemTech, Louisville, KY). Large scale peptide
syntheses were performed on a CS Bio 536 (CS Bio Inc.,
San Carlos, CA). Fmoc-Alanine-OH,
Fmoc-Cysteine(Trityl)-OH, Fmoc-Aspartic acid(tBu)-OH,
Fmoc-Glutamic acid(tBu)-OH, Fmoc-Phenylalanine-OH,
20 Fmoc-Glycine-OH, Fmoc-Histidine(Trityl)-OH,
Fmoc-Isoleucine-OH, Fmoc-Lysine(Boc)-OH, Fmoc-Leucine-OH,
Fmoc-Methionine-OH, Fmoc-Asparagine(Trityl)-OH,
Fmoc-Proline-OH, Fmoc-Glutamine(Trityl)-OH,
Fmoc-Arginine(Ng-2,2,4,6,7-Pentamethyldihydrobenzofuran-5
25 -sulfonyl)-OH, Fmoc-Serine(OtBu)-OH,
Fmoc-Threonine(OtBu)-OH, Fmoc-Valine-OH,
Fmoc-Tryptophan(NinBoc)-OH, Fmoc-Tyrosine(OtBu)-OH,
Fmoc-Cyclohexylalanine-OH, and Fmoc-Norleucine , Fmoc
-O-benzyl-phosphotyrosine were used as protected amino
30 acids. Any corresponding D-amino acids had the same
side-chain protecting groups, with the exception of
Fmoc-D-Arginine, which had a Ng-2,2,5,7,8-pentamethyl-
chroman-6-sulfonyl protecting group.

35

Peptides with C-terminal amides were synthesized on solid

phase using Rink amide-MBHA resin. The Fmoc group of the Rink Amide MBHA resin was removed by treatment with 30% piperidine in DMF for 5 and 30 minutes respectively. After washing with DMF (3 times), methanol (2 times) and DMF/NMP (3 times), the appropriate Fmoc-protected amino acid (4 eq.) was coupled for 2 hours with HBTU or HATU (4eq.) as the activating agent and DIEA (8eq.) as the base. In manual syntheses, the ninhydrin test was used to test for complete coupling of the amino acids. The Fmoc groups were removed by treatment with 30% piperidine in DMF for 5 and 30 minutes respectively. After washing with DMF (3 times), methanol (2 times) and DMF/NMP (3 times), the next Fmoc-protected amino acid (4 eq.) was coupled for 2 hours with HBTU or HATU (4eq.) as the activating agent and DIEA (8eq.) as the base. This process of coupling and deprotection of the Fmoc group was continued until the desired peptide was assembled on the resin. The N-terminal Fmoc group was removed by treatment with 30% piperidine in DMF for 5 and 30 minutes respectively. After washing with DMF (3 times), methanol (2 times), the resin(s) was vacuum dried for 2 hours. Cleavage of the peptide-on-resin and removal of the side chain protecting groups was achieved by treating with TFA : ethanedithiol : thioanisole: m-cresol : water : triisopropylsilane : phenol, 78/5/3/3/3/5/3 (5 mL per 100 mg resin) for 2.5-3 hours. The cleavage cocktail containing the peptide was filtered into a round bottom flask and the volatile liquids were removed by rotary evaporation at 30-40 °C. The peptides were precipitated with anhydrous ether, collected on a medium-pore sintered glass funnel by vacuum filtration, washed with ether and vacuum dried.

Peptides with C-terminal acids were synthesized using 2-chlorotrityl chloride resin. The first amino acid was

attached to the resin by dissolving 0.6-1.2eq. of the appropriate Fmoc-protected amino acid described above in dichloromethane (a minimal amount of DMF was added to facilitate the dissolution, if necessary). To this was
5 added DIEA (4 eq. Relative to the Fmoc-amino acid) and the solution was added to the resin and shaken for 30-120 minutes. The solvents and the excess reagents were drained and the resin was washed with dichloromethane / methanol / DIEA (17/2/1) (3 times), dichloromethane (3
10 times), DMF (2 times), dichloromethane (2 times), and vacuum dried. The process of deprotection of the Fmoc group and coupling the appropriate Fmoc-protected amino acid was continued as described above, until the desired, fully protected peptide was assembled on the resin. The
15 process for removal of the final Fmoc group and the cleavage and deprotection of the peptides was the same as described above for the peptides with C-terminal amides.

Purification of the peptides was achieved by preparative
20 high performance column chromatography (HPLC), using a reverse-phase C-18 column (25 x 250mm) (Primesphere or Vydac) with a gradient of acetonitrile (0.1% TFA) in water (0.1% TFA). The general gradient was from 10%-90% acetonitrile in water over 40 minutes. The fractions
25 corresponding to each peak on the HPLC trace was collected, freeze dried and analyzed by electrospray mass spectrometry. The fraction having the correct mass spectral data corresponding to the desired peptide was then further analyzed by amino acid analysis, if
30 necessary. All purified peptides were tested for homogeneity by analytical HPLC using conditions similar to that described above, but by using a 2.5x250 mm analytical column, and generally were found to have >95%
35 purity.

References:

See our published dihydropyrimidinone and oxazolidinone
patents as references for the synthesis of the templates
and the piperidines.

Also, for the synthesis of the aminopropyl piperidines
and the templates, see:

Lagu, Bharat, et al., Design and synthesis of novel α
adrenoceptor-selective antagonists. 3. Approaches to
eliminate opioid agonist metabolites by using substituted
phenylpiperazine side chains. *J. Med. Chem.* (1999),
42(23), 4794-4803. CODEN: JMCMAR ISSN:0022-2623. CAN
132:78527 AN 1999:680975 CAPLUS

Dhar, T. G. Murali, et al., Design and Synthesis of
Novel α Adrenoceptor-Selective Antagonists. 2.
Approaches To Eliminate Opioid Agonist Metabolites via
Modification of Linker and 4-Methoxycarbonyl-4-phenyl
piperidine Moiety. *J. Med. Chem.* (1999), 42(23),
4778-4793. CODEN: JMCMAR ISSN:0022-2623. CAN 132:18483
AN 1999:680971 CAPLUS

Nagarathnam, Dhanapalan, et al., Design and Synthesis of
Novel α_{1a} Adrenoceptor-Selective Antagonists. 1.
Structure-Activity Relationship in Dihydropyrimidinones.
J. Med. Chem. (1999), 42(23), 4764-4777. CODEN:
JMCMAR ISSN:0022-2623. CAN 132:18482 AN 1999:680967
CAPLUS

Wong, Wai C., et al., Design and Synthesis of Novel α
Adrenoceptor-Selective Antagonists. 4. Structure-Activity
Relationship in the Dihydropyrimidine Series. *J. Med.*
Chem. (1999), 42(23), 4804-4813. CODEN: JMCMAR

ISSN:0022-2623. CAN 132:30317 AN 1999:680947 CAPLUS

Marzabadi, Mohammad R., et al., Design and synthesis of
novel dihydropyridine alpha-1A antagonists. *Bioorg.*
5 *Med. Chem. Lett.* (1999), 9(19), 2843-2848. CODEN:
BMCLE8 ISSN:0960-894X. CAN 132:44482 AN 1999:662323
CAPLUS

Wong, Wai C., et al., Alpha-1a adrenoceptor selective
10 antagonists as novel agents for treating benign prostatic
hyperplasia. Book of Abstracts, 217th ACS National
Meeting, Anaheim, Calif., March 21-25 (1999),
MEDI-156. CODEN: 67GHA6 AN 1999:92669 CAPLUS

15 Nagarathnam, D., et al., Design, synthesis and
evaluation of dihydropyrimidinones as alpha-1a selective
antagonists: 7. Modification of the piperidine moiety
into 4-aminocyclohexane; identification and
structure-activity relationship of SNAP 6991 analogs.
20 Book of Abstracts, 217th ACS National Meeting, Anaheim,
Calif., March 21-25 (1999), MEDI-110. CODEN: 67GHA6
AN 1999:92624 CAPLUS

Lagu, Bharat, et al., Heterocyclic substituted
25 oxazolidinones for use as selective antagonists for human
a 1A receptors. PCT Int. Appl. (1998), 258 pp.
CODEN: PIXXD2 WO 9857940 A1 19981223 CAN 130:81508
AN 1999:9823 CAPLUS

30 Wong, Wai C., et al., Preparation of piperidinylpropyl
aminocarbonyldihydropyrimidones and related compounds as
selective adrenergic a 1A receptor antagonists. PCT
Int. Appl. (1998), 314 pp. CODEN: PIXXD2 WO
9851311 A2 19981119 CAN 130:25077 AN 1998:764290
35 CAPLUS

Nagarathnam, Dhanapalan, et al., Design and synthesis of novel α_1 adrenoceptor-selective dihydropyridine antagonists for the treatment of benign prostatic hyperplasia. *J. Med. Chem.* (1998), 41(26), 5320-5333. CODEN: JMCMAR ISSN:0022-2623. CAN 130:110137 AN 1998:742998 CAPLUS

For the general procedure for Pd coupling of vinyl triflate and bononic acids or tributyl tin reagents: See, Wuston, Wise *Synthesis* 1991, 993)

(For Typical References, See:Schroeter, G. *Ber.* (1909) 42, 3356; and Allen, C.F.H.; Bell, A. *Org. Syn. Coll. Vol. 3*, (1955) 846).

For the preparation of the ether N-[4-(benzo-4',5'[H]-furanpiperidine refer to W.E.Parham et al, *J. Org. Chem.* (1976) 41, 2268.

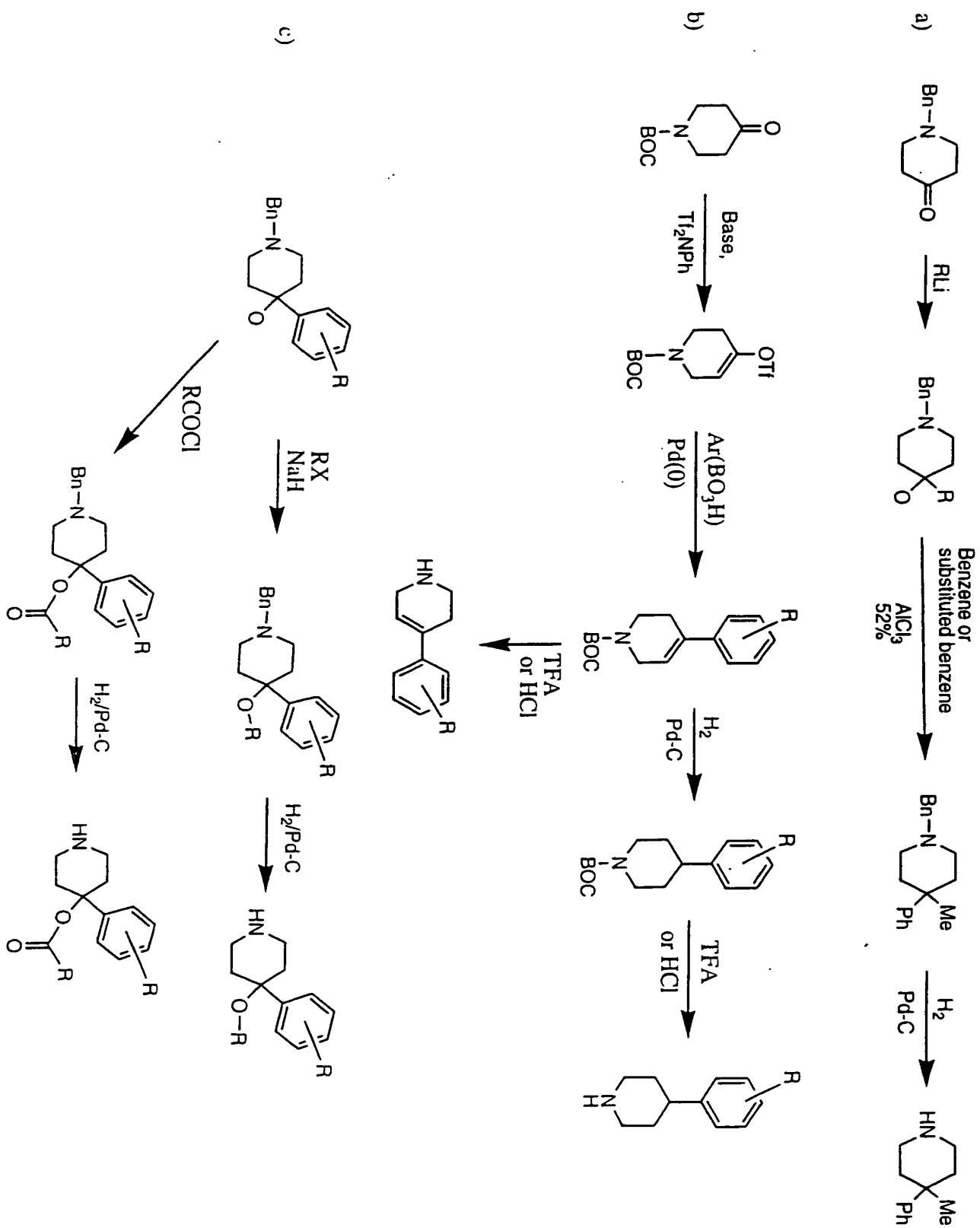
For the preparation of the ether piperidine precursor of Example 20, refer to W.E.Parham et al, *J. Org. Chem.* (1976) 41, 2268.

For the preparation of the indane piperidine precursor of Example 21, refer to M.S.Chambers *J. Med. Chem.* (1992) 35, 2033.

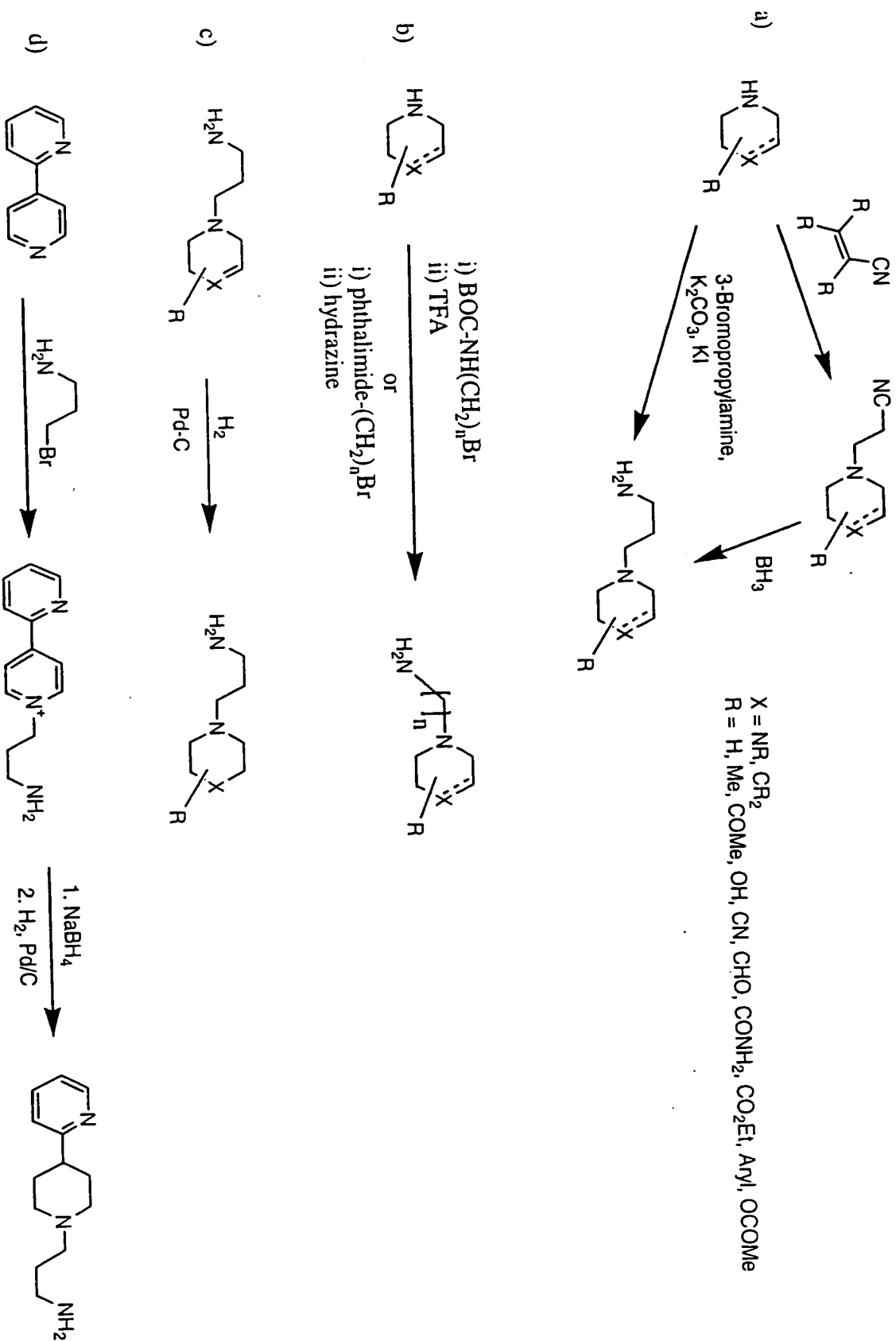
For the preparation of the piperidine precursor of Example 23, (K.Hashigaki et al. *Chem.Pharm.Bull.* (1984) 32, 3568.)

For the preparation of the piperidine precursor of Example 32, spiro[1H-indane-1,4'-piperidine], refer to M.S.Chambers et al. *J. Med. Chem.* (1992) 35, 2033.)

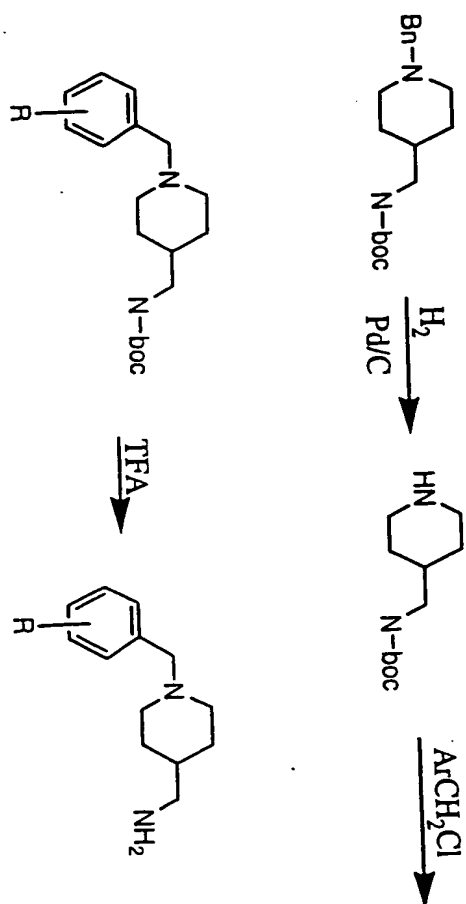
Scheme 1. Synthesis of Precursor Compounds



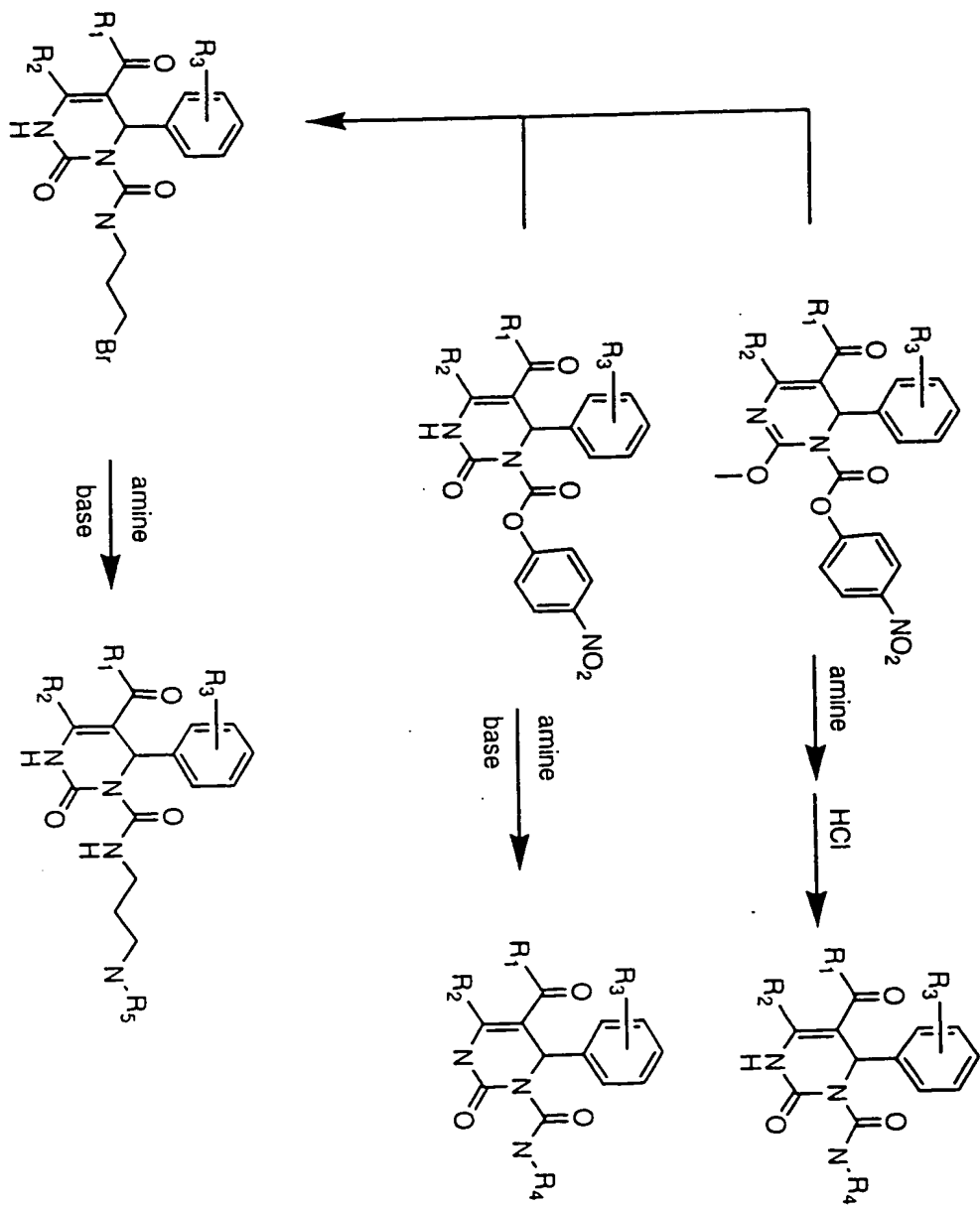
Scheme 2. Synthesis of Precursor Compounds



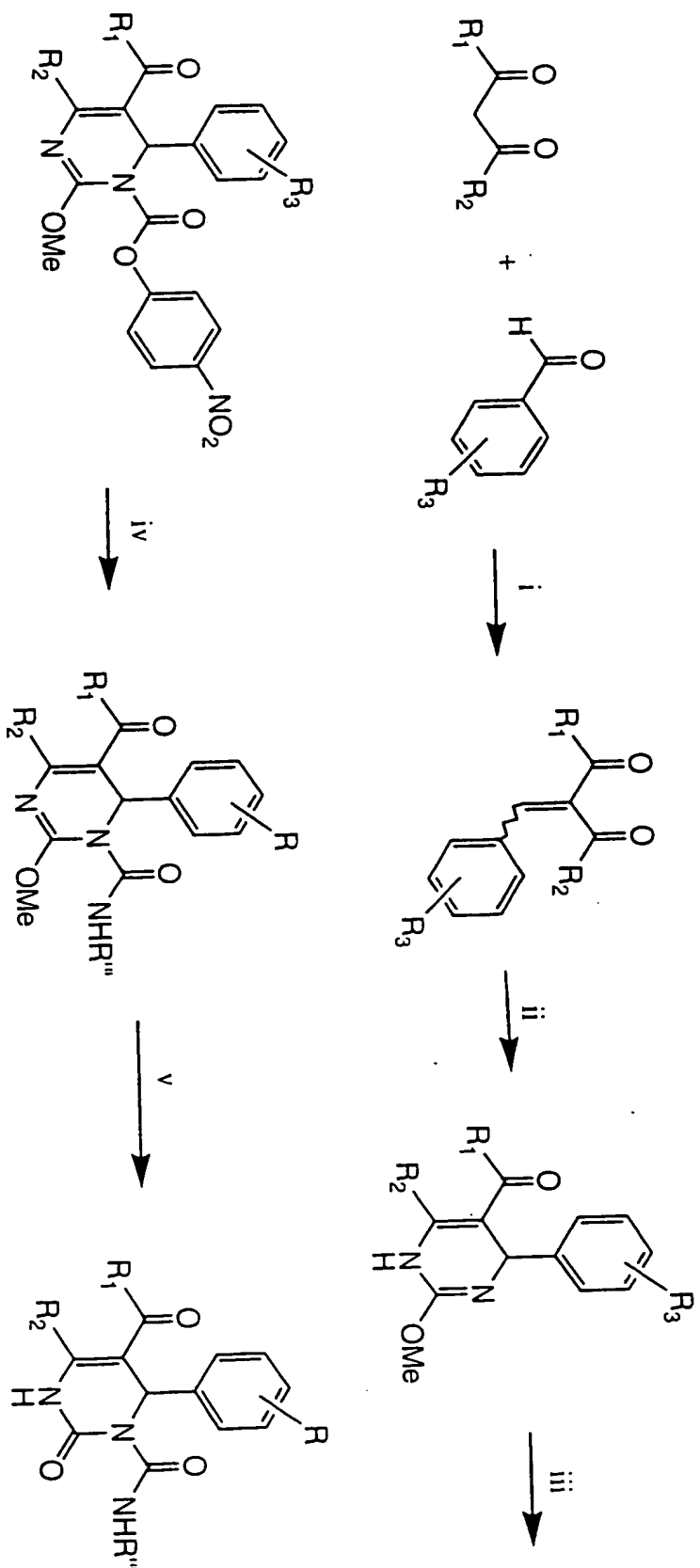
Scheme 3. Synthesis of Precursor Compounds



Scheme 4. Synthesis of Various Dihydropyrimidinones

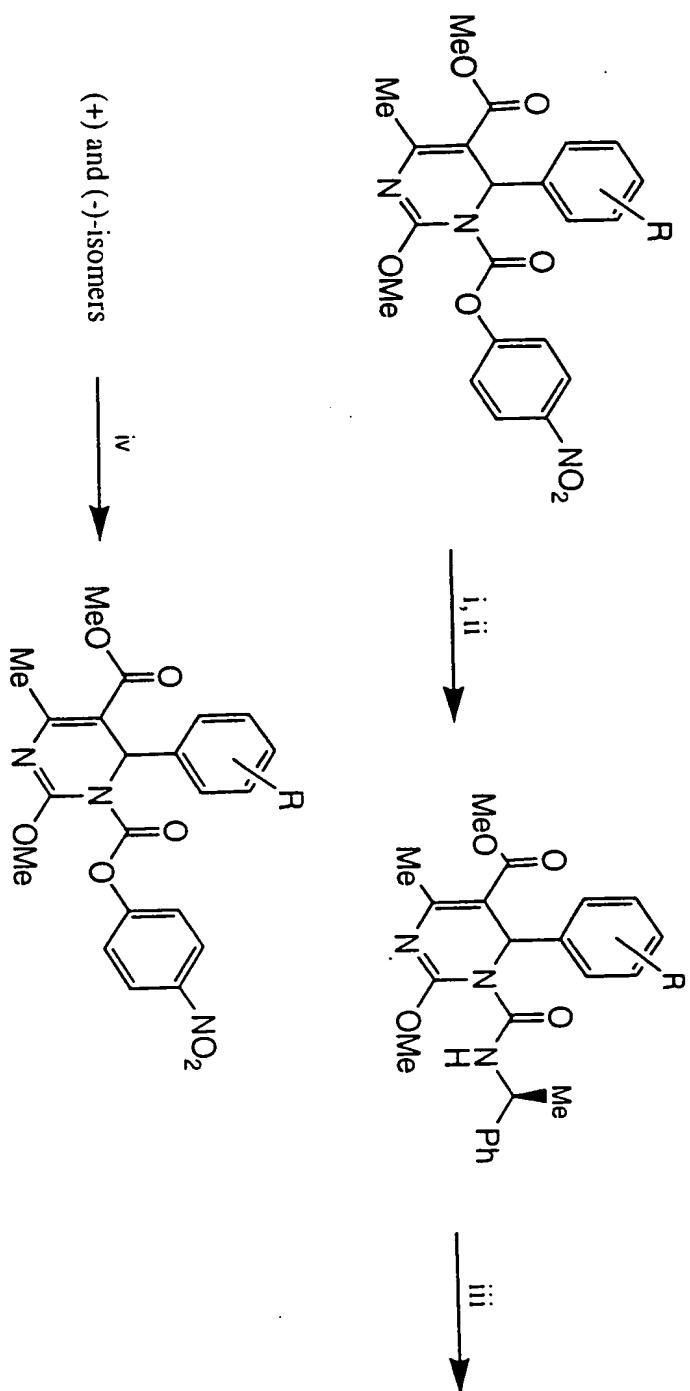


Scheme 5. Synthesis of Dihydropyrimidinones



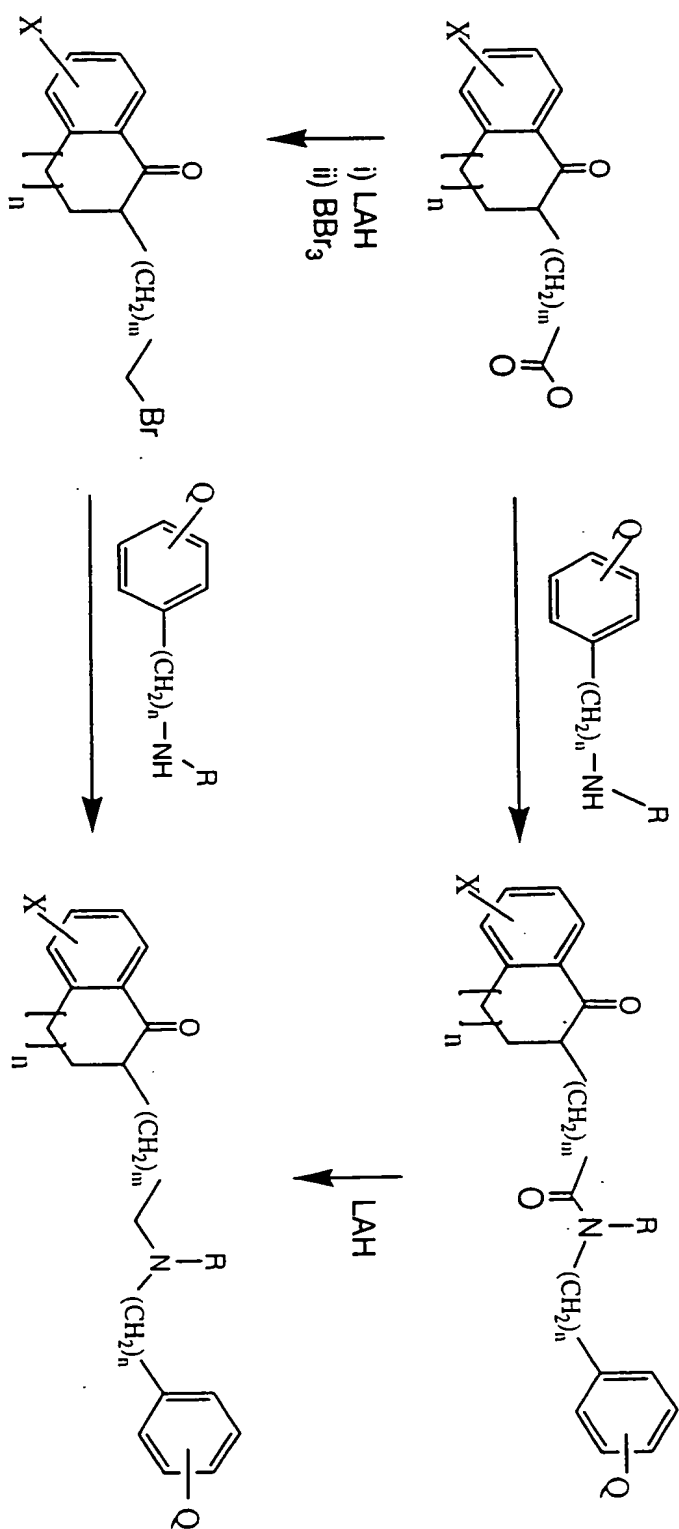
- i. *O*-Methylisourea, NaHCO_3 , DMF
- ii. $\text{NaOAc}/\text{NaHCO}_3$, DMF
- iii. 4-Nitrophenyl chloroformate, DMAP, CH_2Cl_2
- iv. Amine
- v. HCl/THF

Scheme 6. Resolution of dihydropyrimidinones.



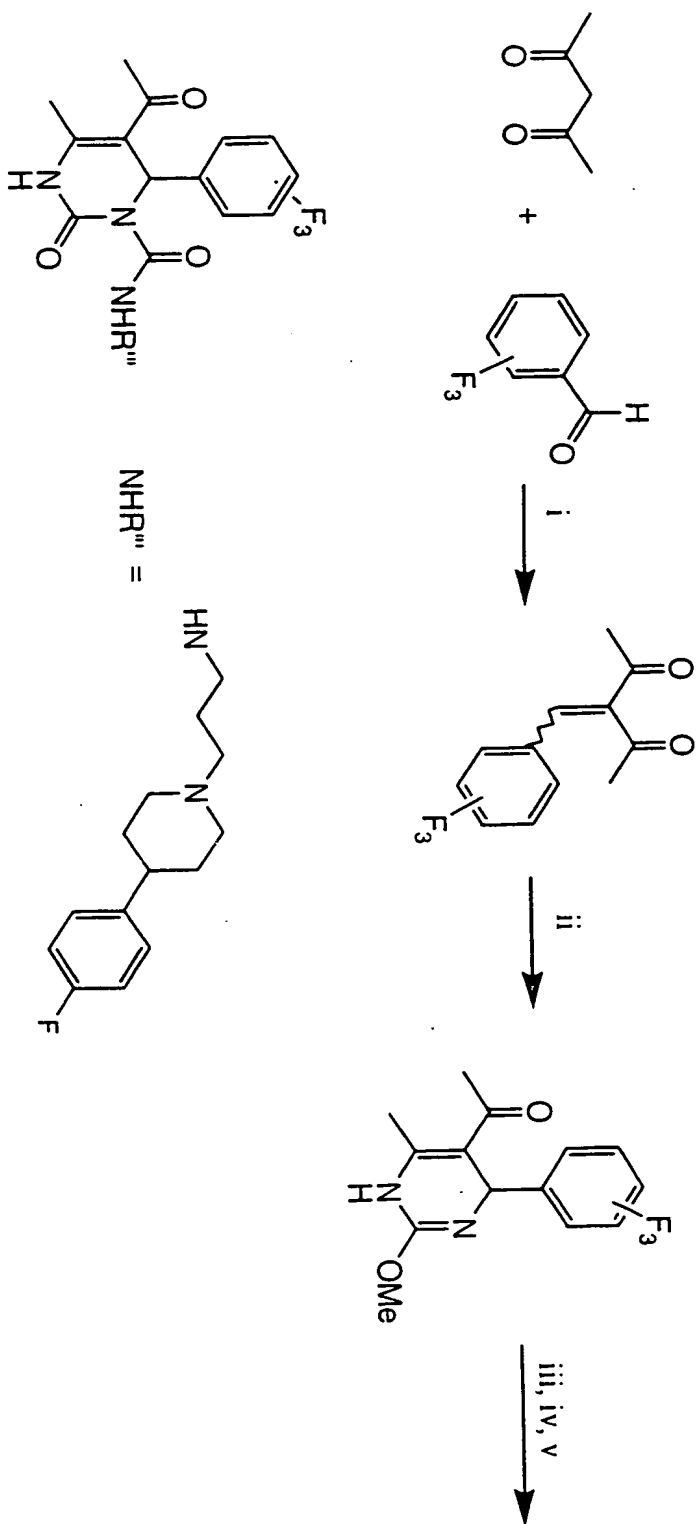
- i. S-(-)- α -Methylbenzylamine
- ii. Sepn. of diastereomers
- iii. DBU
- iv. p-nitrophenylchloroformate

Scheme 7. Synthesis of Example 5 and Analogs

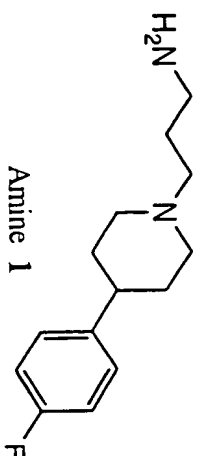


• • • •

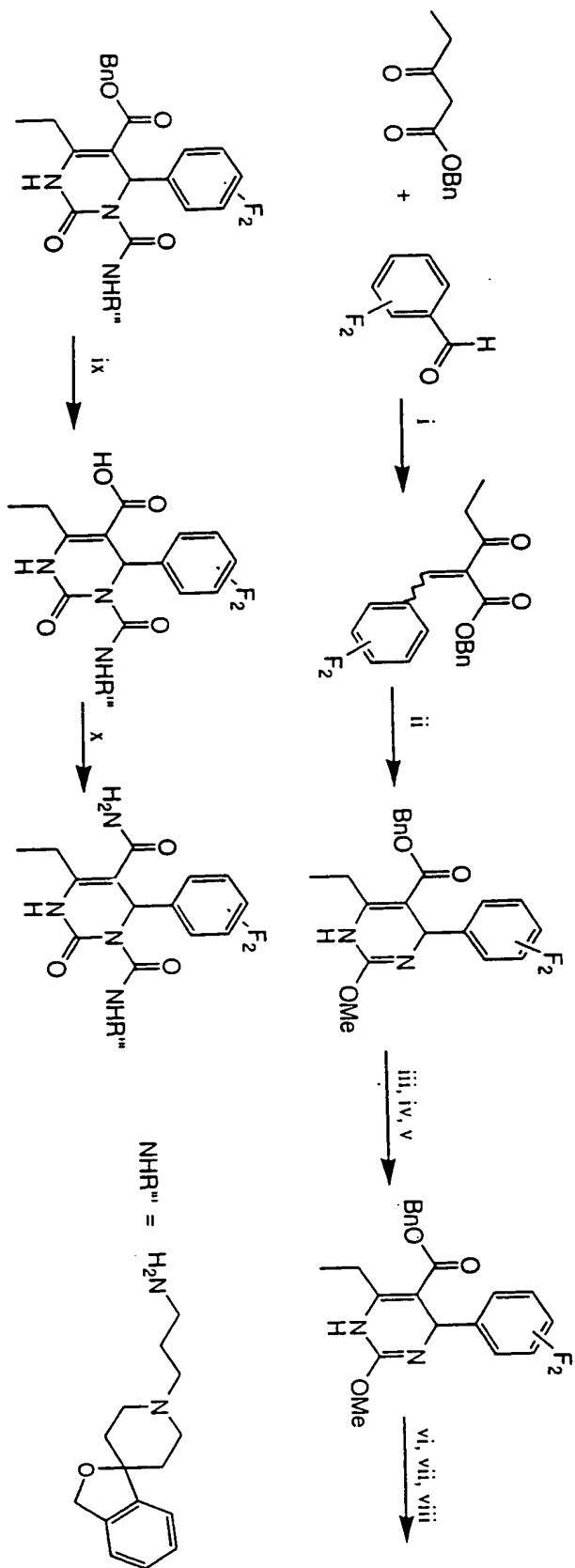
Scheme 9. Synthesis of Example 12



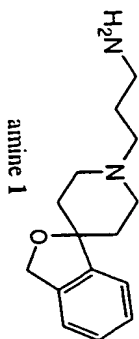
- i. Piperidine, Benzene
- ii. O-Methylisourea, $NaHCO_3$, DMF
- iii. 4-Nitrophenyl chloroformate, Pyridine, CH_2Cl_2
- iv. Amine 1
- v. 6 N HCl



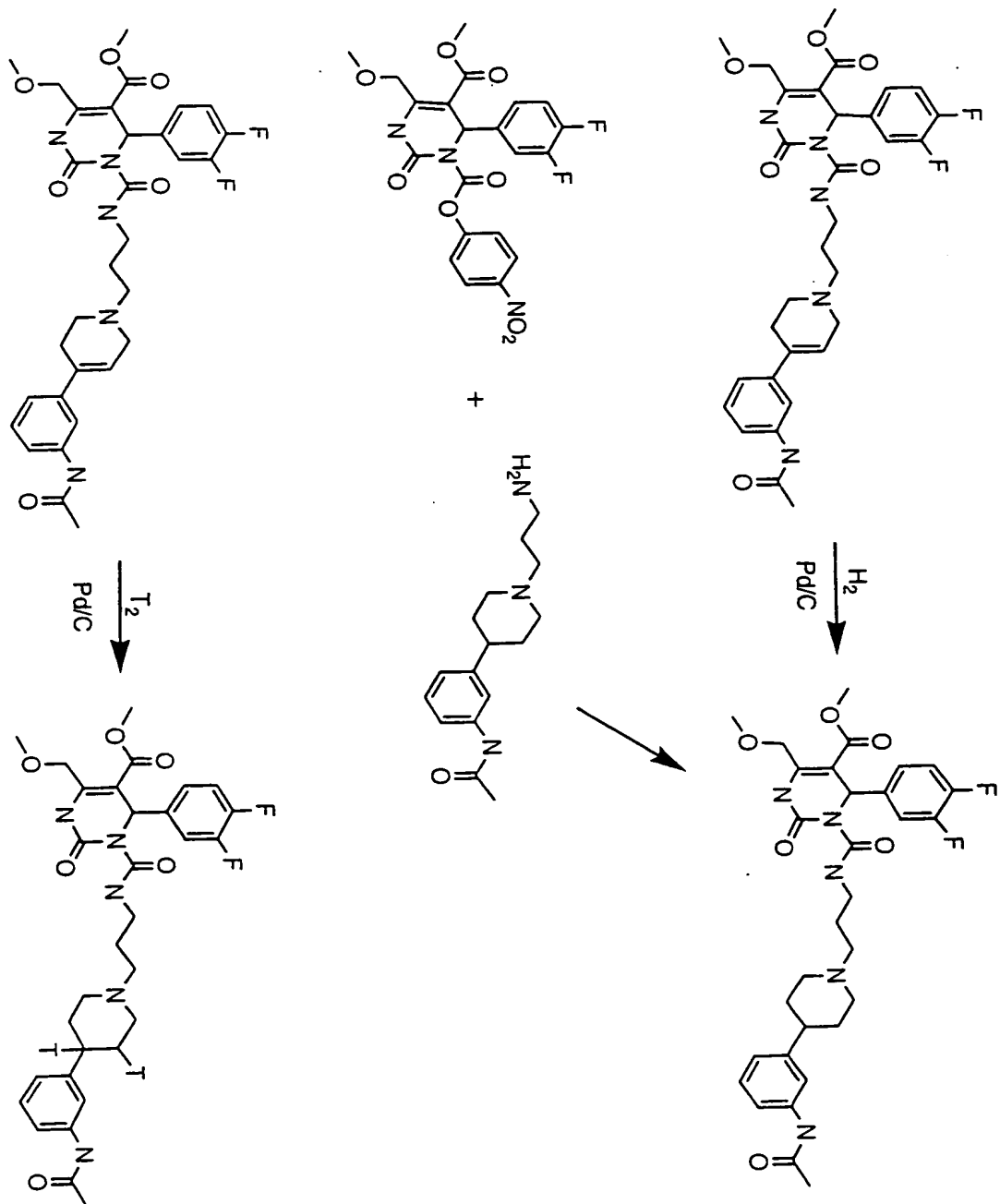
Scheme 10. Synthesis of Examples 4 and 22.



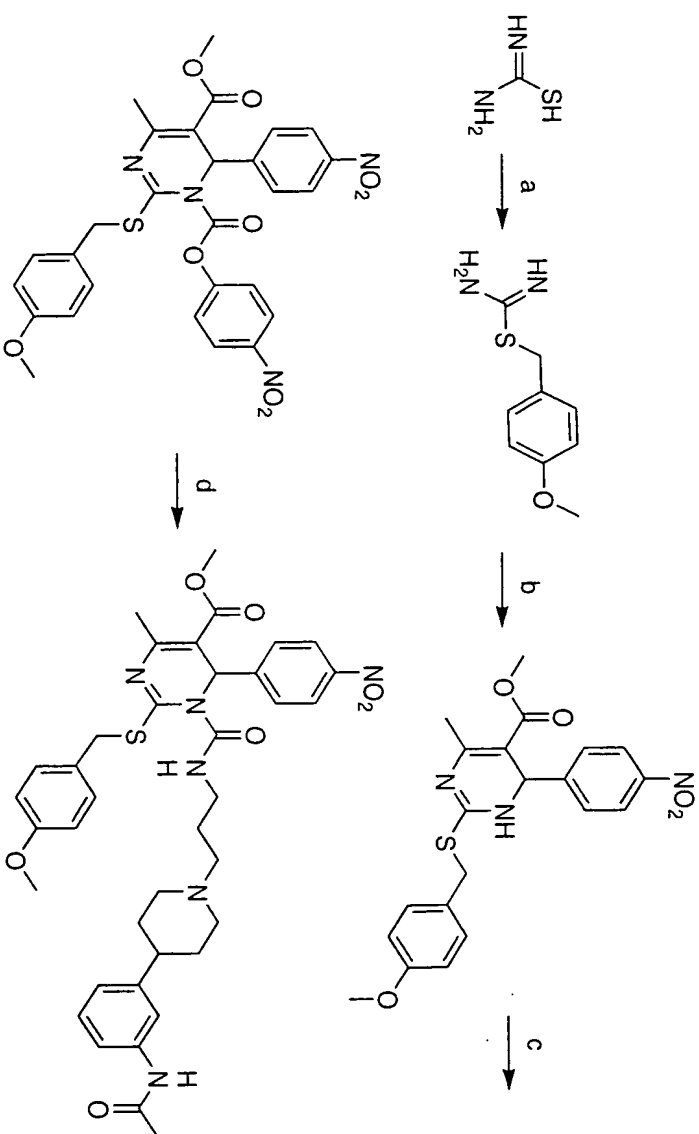
- i. Piperidine, Benzene
- ii. *O*-Methylisourea, NaHCO_3 , DMF
- iii. 4-Nitrophenyl chloroformate, Pyridine, CH_2Cl_2
- iv. *R*-(+)-Phenethylamine and separate diastereomers
- v. DBU
- vi. 4-Nitrophenyl chloroformate, Pyridine, CH_2Cl_2
- vii. Amine 1
- viii. 6 N HCl
- ix. H_2 , Pd-C, MeOH/water
- x. EDC, NMM, NH_4OH , CH_2Cl_2



Scheme 11. Synthesis of Example 10 and its Tritiated Analog

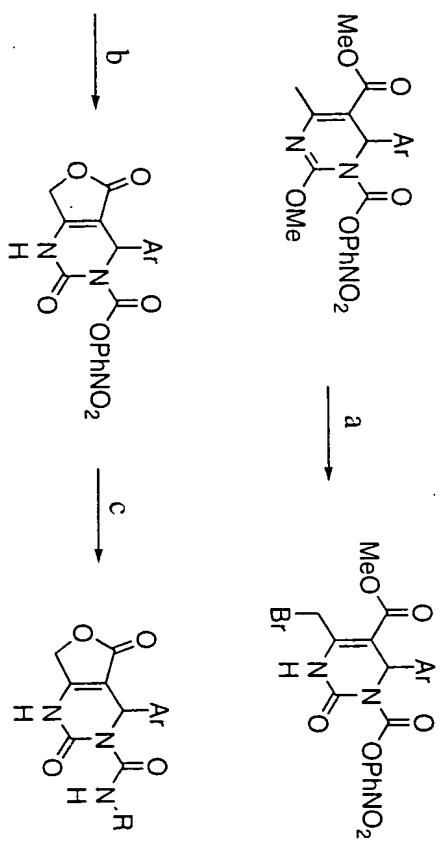


Scheme 12: Synthesis of Dinydropyrimidines

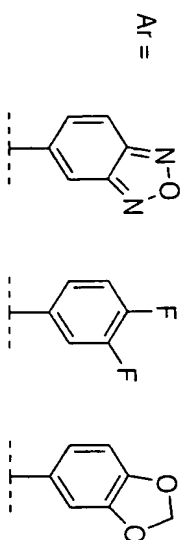


- p-methoxybenzyl chloride, THF, 0 to 65 °C;
- Methyl 2-((4-nitrophenyl)methylene)-3-oxobutylate (prepared from p-nitrobenzaldehyde, methyl acetoacetate, piperidinium acetate in isopropanol), NaOAc, DMF, 65 °C;
- p-nitrophenyl chloroformate, NaHCO₃, dichloromethane
- N-(3-[1-(3-aminopropyl)-4-piperidinyl]phenyl)acetamide

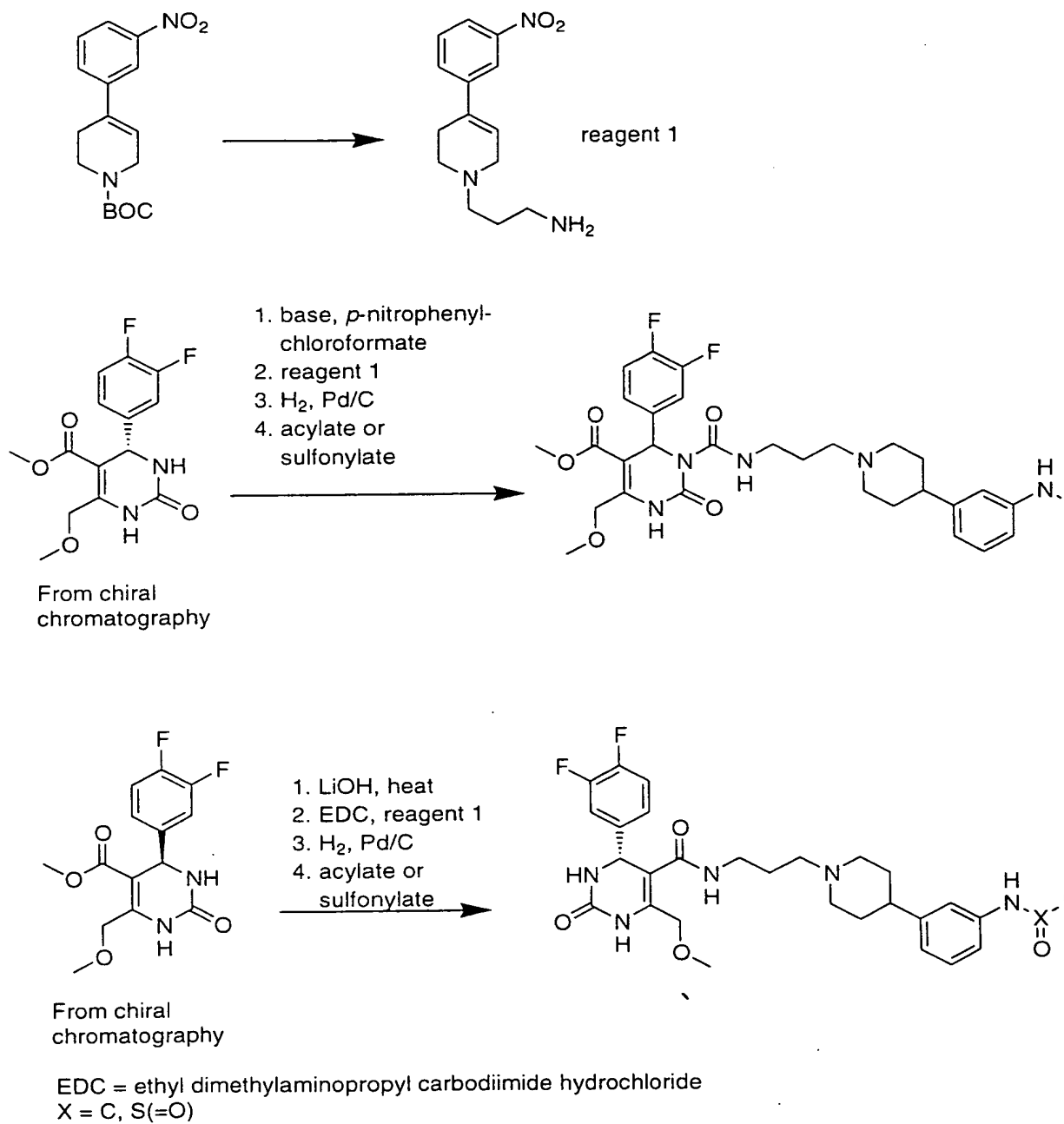
Scheme 13. Synthesis of Dihydropyrimidinone Fused Lactones



(a) Br₂, CHCl₃ (b) Heat, 130 °C (c) RNH₂, THF or CH₂Cl₂, 60-80% yield overall.



Scheme 14: Synthesis of Substituted Dihydropyrimidinones and Reverse Dihydropyrimidinones



II. Synthetic Methods for General Structures

The examples described in Section I are merely illustrative of the methods used to synthesize MCH1 antagonists. Further derivatives may be obtained utilizing generalized methods based on the synthetic methods used to synthesize the examples.

It may be necessary to incorporate protection and deprotection strategies for substituents such as amino, amido, carboxylic acid, and hydroxyl groups in the generalized synthetic methods to form further derivatives. Methods for protection and deprotection of such groups are well-known in the art, and may be found, for example in Green, T.W. and Wuts, P.G.M. (1991) Protection Groups in Organic Synthesis, 2nd Edition John Wiley & Sons, New York.

III. Oral Compositions

As a specific embodiment of an oral composition of a compound of this invention, 100 mg of one of the compounds described herein is formulated with sufficient finely divided lactose to provide a total amount of 580 to 590 mg to fill a size O hard gel capsule.

IV. Pharmacological Evaluation of Compounds at Cloned MCH1, NPY, Galanin, and 5-HT2C Receptors

The pharmacological properties of the compounds of the present invention were evaluated at one or more of the cloned human MCH1, NPY1, NPY5, GALR1, GALR2, and GALR3 and rat 5-HT2C receptors using protocols described below.

Host cells

A broad variety of host cells can be used to study heterologously expressed proteins. These cells include but

are not restricted to assorted mammalian lines such as; Cos-7, CHO, LM(tk-), HEK293, etc.; insect cell lines such as; Sf9, Sf21, etc.; amphibian cells such as xenopus oocytes; and others.

5

COS-7 cells are grown on 150 mm plates in DMEM with supplements (Dulbecco's Modified Eagle Medium with 10% bovine calf serum, 4 mM glutamine, 100 units/ml penicillin/100 µg/ml streptomycin) at 37°C, 5% CO₂. Stock plates of COS-7 cells are trypsinized and split 1:6 every 3-4 days.

10

Human embryonic kidney 293 cells are grown on 150 mm plates in DMEM with supplements (10% bovine calf serum, 4 mM glutamine, 100 units/ml penicillin/100 µg/ml streptomycin) at 37°C, 5% CO₂. Stock plates of 293 cells are trypsinized and split 1:6 every 3-4 days.

15

Mouse fibroblast LM(tk-) cells are grown on 150 mm plates in D-MEM with supplements (Dulbecco's Modified Eagle Medium with 10% bovine calf serum, 4 mM glutamine, 100 units/ml penicillin/100 µg/ml streptomycin) at 37°C, 5% CO₂. Stock plates of LM(tk-) cells are trypsinized and split 1:10 every 3-4 days.

20

25

Chinese hamster ovary (CHO) cells were grown on 150 mm plates in HAM's F-12 medium with supplements (10% bovine calf serum, 4 mM L-glutamine and 100 units/ml penicillin/100 µg/ml streptomycin) at 37°C, 5% CO₂. Stock plates of CHO cells are trypsinized and split 1:8 every 3-4 days.

30

Mouse embryonic fibroblast NIH-3T3 cells are grown on 150 mm plates in Dulbecco's Modified Eagle Medium (DMEM) with supplements (10% bovine calf serum, 4 mM glutamine, 100 units/ml penicillin/100 µg/ml streptomycin) at 37°C, 5% CO₂.

35

Stock plates of NIH-3T3 cells are trypsinized and split 1:15 every 3-4 days.

Sf9 and Sf21 cells are grown in monolayers on 150 mm tissue culture dishes in TMN-FH media supplemented with 10% fetal calf serum, at 27°C, no CO₂. High Five insect cells are grown on 150 mm tissue culture dishes in Ex-Cell 400[™] medium supplemented with L-Glutamine, also at 27°C, no CO₂.

In some cases, cell lines that grow as adherent monolayers can be converted to suspension culture to increase cell yield and provide large batches of uniform assay material for routine receptor screening projects.

Transient expression

DNA encoding proteins to be studied can be transiently expressed in a variety of mammalian, insect, amphibian and other cell lines by several methods including but not restricted to; calcium phosphate-mediated, DEAE-dextran mediated, Liposomal-mediated, viral-mediated, electroporation-mediated and microinjection delivery. Each of these methods may require optimization of assorted experimental parameters depending on the DNA, cell line, and the type of assay to be subsequently employed.

A typical protocol for the calcium phosphate method as applied to LM(tk-) cells is described as follows; Adherent cells are harvested approximately twenty-four hours before transfection and replated at a density of $1-2 \times 10^5$ cells/cm² in a 100 mm tissue culture dish and allowed to incubate over night at 37°C at 5% CO₂. 250 µl of a mixture of CaCl₂ and DNA (20 µg DNA in 250 mM CaCl₂) is added to a 5 ml plastic tube and 250 µl of 2X HBS (250 mM NaCl, 10 mM KCl, 1.5 mM Na₂HPO₄, 12 mM dextrose, 50 mM HEPES) is slowly added with gentle mixing. The mixture is allowed to

incubate for 20 minutes at room temperature to allow a DNA precipitate to form. The cells are then washed with complete medium, 10 ml of culture medium is added to each plate, followed by addition of the DNA precipitate. The
5 cells are then incubated for 24 to 48 hours at 37°C at 5% CO₂.

A typical protocol for the DEAE-dextran method as applied to Cos-7 cells is described as follows; Cells to be used
10 for transfection are split 24 hours prior to the transfection to provide flasks which are 70-80% confluent at the time of transfection. Briefly, 8 µg of receptor DNA plus 8 µg of any additional DNA needed (e.g. G_s protein expression vector, reporter construct, antibiotic
15 resistance marker, mock vector, etc.) are added to 9 ml of complete DMEM plus DEAE-dextran mixture (10 mg/ml in PBS). Cos-7 cells plated into a T225 flask (sub-confluent) are washed once with PBS and the DNA mixture is added to each flask. The cells are allowed to incubate for 30 minutes at
20 37 C, 5% CO₂. Following the incubation, 36 ml of complete DMEM with 80 µM chloroquine is added to each flask and allowed to incubate an additional 3 hours. The medium is then aspirated and 24 ml of complete medium containing 10% DMSO for exactly 2 minutes and then aspirated. The cells
25 are then washed 2 times with PBS and 30 ml of complete DMEM added to each flask. The cells are then allowed to incubate over night. The next day the cells are harvested by trypsinization and reseeded as needed depending upon the type of assay to be performed.

30

A typical protocol for liposomal-mediated transfection as applied to CHO cells is described as follows; Cells to be used for transfection are split 24 hours prior to the transfection to provide flasks which are 70-80% confluent
35 at the time of transfection. A total of 10µg of DNA which

may include varying ratios of receptor DNA plus any additional DNA needed (e.g. G. protein expression vector, reporter construct, antibiotic resistance marker, mock vector, etc.) is used to transfect each 75 cm² flask of cells. Liposomal mediated transfection is carried out according to the manufacturer's recommendations (LipofectAMINE, GibcoBRL, Bethesda, MD). Transfected cells are harvested 24 h post transfection and used or reseeded according the requirements of the assay to be employed.

A typical protocol for the electroporation method as applied to Cos-7 cells is described as follows; Cells to be used for transfection are split 24 hours prior to the transfection to provide flasks which are subconfluent at the time of transfection. The cells are harvested by trypsinization resuspended in their growth media and counted. 4×10^6 cells are suspended in 300 μ l of DMEM and placed into an electroporation cuvette. 8 μ g of receptor DNA plus 8 μ g of any additional DNA needed (e.g. G_a protein expression vector, reporter construct, antibiotic resistance marker, mock vector, etc.) is added to the cell suspension, the cuvette is placed into a BioRad Gene Pulser and subjected to an electrical pulse (Gene Pulser settings: 0.25 kV voltage, 950 μ F capacitance). Following the pulse, 300 μ l of complete DMEM is added to each cuvette and the suspension transferred to a sterile tube. Complete medium is added to each tube to bring the final cell concentration to 1×10^6 cells/100 μ l. The cells are then plated as needed depending upon the type of assay to be performed.

A typical protocol for viral mediated expression of heterologous proteins is described as follows for baculovirus infection of insect Sf9 cells. The coding region of DNA encoding the receptor disclosed herein may be subcloned into pBlueBacIII into existing restriction sites

or sites engineered into sequences 5' and 3' to the coding region of the polypeptides. To generate baculovirus, 0.5 µg of viral DNA (BaculoGold) and 3 µg of DNA construct encoding a polypeptide may be co-transfected into 2 x 10⁷ *Spodoptera frugiperda* insect Sf9 cells by the calcium phosphate co-precipitation method, as outlined in by Pharmingen (in "Baculovirus Expression Vector System: Procedures and Methods Manual"). The cells then are incubated for 5 days at 27°C. The supernatant of the co-transfection plate may be collected by centrifugation and the recombinant virus plaque purified. The procedure to infect cells with virus, to prepare stocks of virus and to titer the virus stocks are as described in Pharmingen's manual. Similar principals would in general apply to mammalian cell expression via retro-viruses, Simliki forest virus and double stranded DNA viruses such as adeno-, herpes-, and vacinia-viruses, and the like.

Stable expression

Heterologous DNA can be stably incorporated into host cells, causing the cell to perpetually express a foreign protein. Methods for the delivery of the DNA into the cell are similar to those described above for transient expression but require the co-transfection of an ancillary gene to confer drug resistance on the targeted host cell. The ensuing drug resistance can be exploited to select and maintain cells that have taken up the heterologous DNA. An assortment of resistance genes are available including but not restricted to Neomycin, Kanamycin, and Hygromycin. For the purposes of receptor studies, stable expression of a heterologous receptor protein is carried out in, but not necessarily restricted to, mammalian cells including, CHO, HEK293, LM(tk-), etc.

Cell membrane preparation

For binding assays, pellets of transfected cells are suspended in ice-cold buffer (20 mM Tris.HCl, 5 mM EDTA, pH 7.4) and homogenized by sonication for 7 sec. The cell lysates are centrifuged at 200 x g for 5 min at 4°C. The supernatants are then centrifuged at 40,000 x g for 20 min at 4°C. The resulting pellets are washed once in the homogenization buffer and suspended in binding buffer (see methods for radioligand binding). Protein concentrations are determined by the method of Bradford (1976) using bovine serum albumin as the standard. Binding assays are usually performed immediately, however it is possible to prepare membranes in batch and store frozen in liquid nitrogen for future use.

Radioligand binding assays

Radioligand binding assays for the MCH1 receptor were carried out using plasmid pEXJ.HR-TL231 (ATCC Accession No. 203197). Plasmid pEXJ.HR-TL231 comprises the regulatory elements necessary for expression of DNA in a mammalian cell operatively linked to DNA encoding the human MCH1 receptor so as to permit expression thereof. Plasmid pEXJ.HR-TL231 was deposited on September 17, 1998, with the American Type Culture Collection (ATCC), 12301 Parklawn Drive, Rockville, Maryland 20852, U.S.A. under the provisions of the Budapest Treaty for the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure and was accorded ATCC Accession No. 203197.

Human embryonic kidney 293 cells (A293 cells) were stably transfected with DNA encoding the MCH1 receptor utilizing the calcium phosphate method and cell membranes were prepared as described above. Binding experiments with membranes from A293 cells transfected with the human MCH1

receptor were performed with 0.08 nM [³H]Compound 10 (custom labeled by Amersham) using an incubation buffer consisting of 50 mM Tris pH 7.4, 10 mM MgCl₂, 0.16 mM PMSF, 1 mM 1,10 phenantroline and 0.2% BSA. Binding was performed at 25°C for 90 minutes. Incubations were terminated by rapid vacuum filtration over GF/C glass fiber filters, presoaked in 5% PEI using 50 mM Tris pH 7.4 as wash buffer. In all experiments, nonspecific binding is defined using 10 μM Compound 10.

The methods to obtain the cDNA of the human NPY1, NPY5, GALR1, GALR2, and GALR3 and rat 5-HT2C receptors, express said receptors in heterologous systems, and carry out assays to determine binding affinity are described in the following publications and above: human NPY1 (Larhammar et al., 1992), human NPY5 (U.S. Patent No. 5,602,024, the disclosure of which is hereby incorporated by reference in its entirety into this application), human Gal1 (Habert-Ortoli et al., 1994), human Gal2 (Smith et al., 1997), human Gal3 (Smith et al., 1998), and rat 5-HT2C (Julius et al., 1988).

Functional assays

Cells may be screened for the presence of endogenous mammalian receptor using functional assays (described in detail below). Cells with no or a low level of endogenous receptor present may be transfected with the exogenous receptor for use in the following functional assays.

A wide spectrum of assays can be employed to screen for receptor activation. These range from traditional measurements of phosphatidyl inositol, cAMP, Ca⁺⁺, and K⁺, for example; to systems measuring these same second messengers but which have been modified or adapted to be higher throughput, more generic, and more sensitive; to

cell based platforms reporting more general cellular events resulting from receptor activation such as metabolic changes, differentiation, and cell division/proliferation, for example; to high level organism assays which monitor complex physiological or behavioral changes thought to be involved with receptor activation including cardiovascular, analgesic, orexigenic, anxiolytic, and sedation effects, for example.

10 **Functional assay:**

Intracellular calcium mobilization assay

Intracellular calcium mobilization assays for the MCH1 receptor were carried out using plasmid pEXJ.HR-TL231 (ATCC Accession No. 203197). COS-7 cells were transiently transfected with DNA encoding the MCH1 receptor utilizing the DEAE-dextran method as described above. The intracellular free calcium concentration was measured by fluorescent imaging using the calcium sensitive fluorescent dye Fluo-3. COS-7 cells expressing the human MCH1 receptor were seeded onto sterile 96 well plates, washed with Hank's balanced salt solution (HBSS), containing 20 mM HEPES, 2.5 mM probenecid, and 0.1% BSA, and loaded with the same buffer containing 3.8 μ M Fluo-3 for 1 hour at 37°C. After washing with HBSS to remove the fluo-3 solution, cells were equilibrated for 10 minutes. Cells were then incubated with, or without MCH, and the fluorescence is measured using a Fluorescence Imaging Plate Reader (FLIPR, Molecular Devices).

30 **Materials**

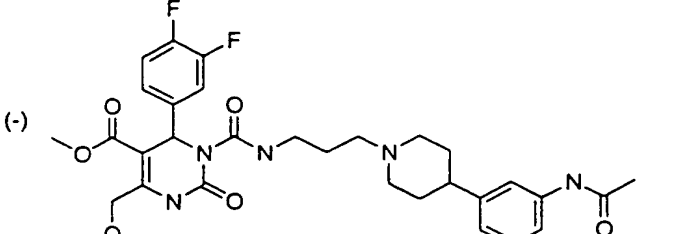
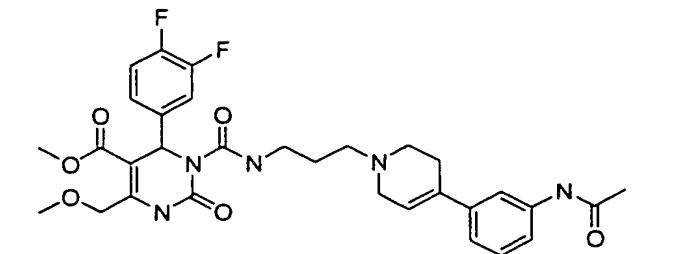
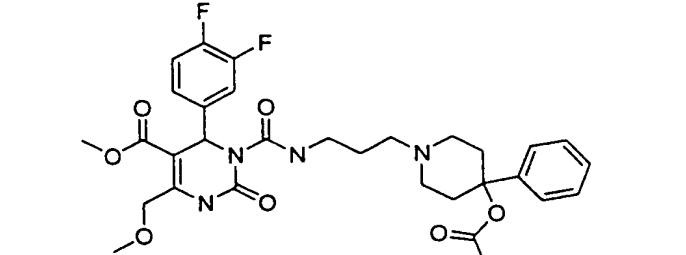
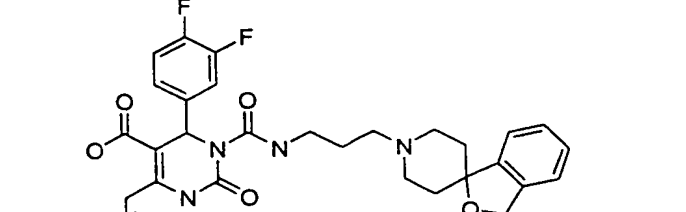
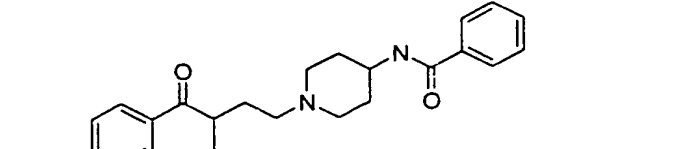
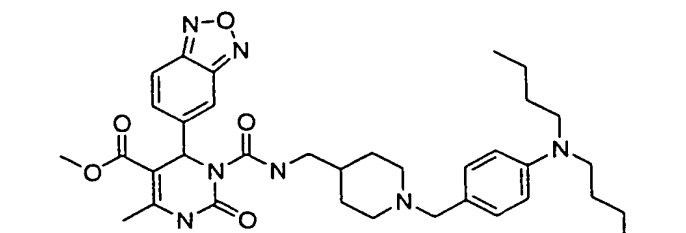
Cell culture media and supplements were from Specialty Media (Lavallette, NJ). Cell culture plates (150 mm and 96-well microtiter) were from Corning (Corning, NY). Sf9, Sf21, and High Five insect cells, as well as the baculovirus transfer plasmid, pBlueBacIIITM, were purchased

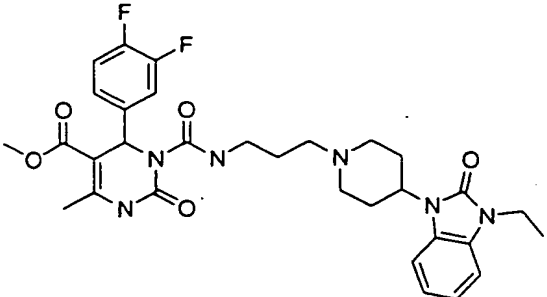
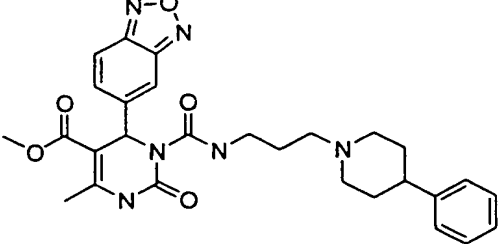
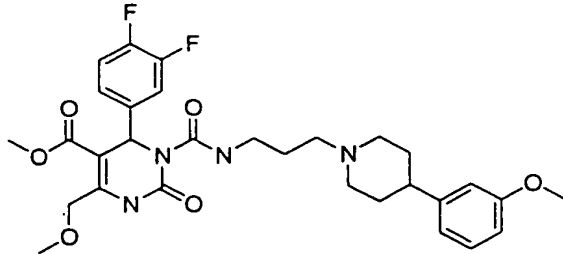
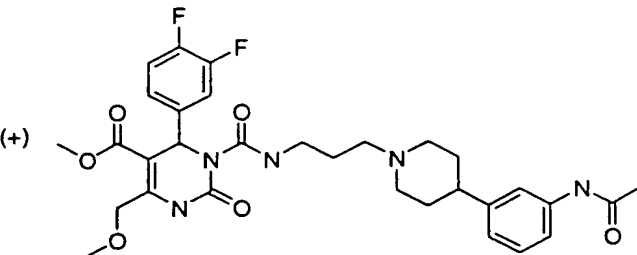
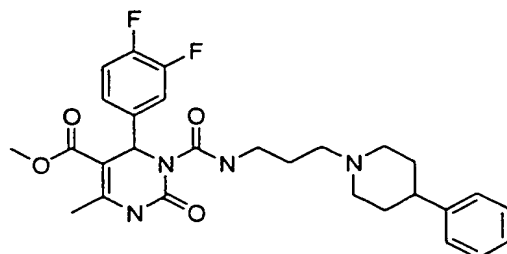
from Invitrogen (San Diego, CA). TMN-FH insect medium complemented with 10% fetal calf serum, and the baculovirus DNA, BaculoGold™, was obtained from Pharmingen (San Diego, CA.). Ex-Cell 400™ medium with L-Glutamine was purchased from JRH Scientific. Polypropylene 96-well microtiter plates were from Co-star (Cambridge, MA). Commercially available MCH and related peptide analogs were either from Bachem California (Torrance, CA) or Peninsula (Belmont, CA). Bio-Rad Reagent was from Bio-Rad (Hercules, CA). Bovine serum albumin (ultra-fat free, A-7511) was from Sigma (St. Louis. MO). All other materials were reagent grade.

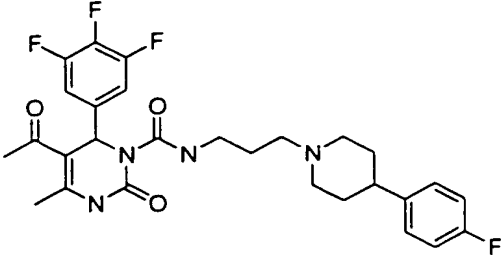
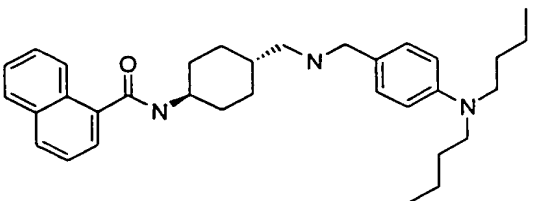
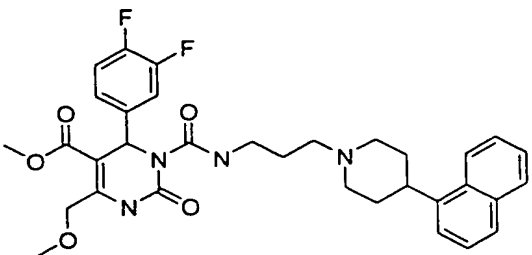
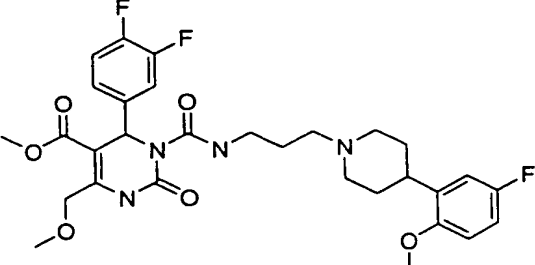
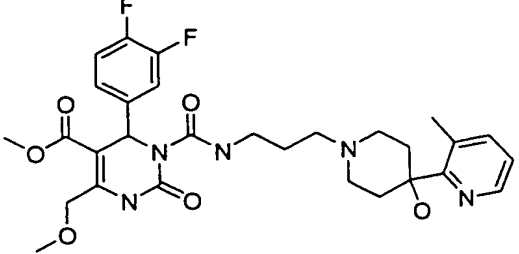
Functional Assay Results

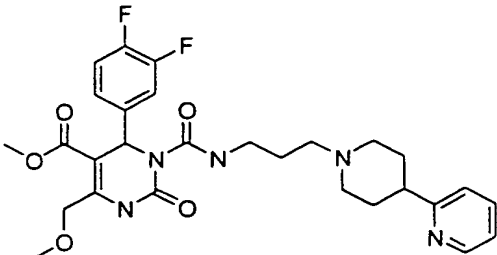
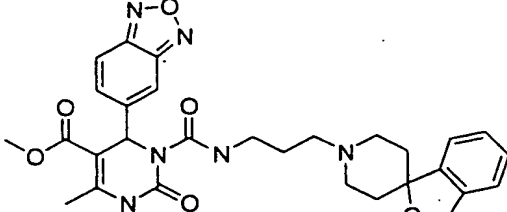
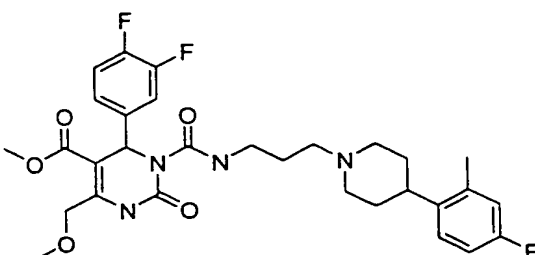
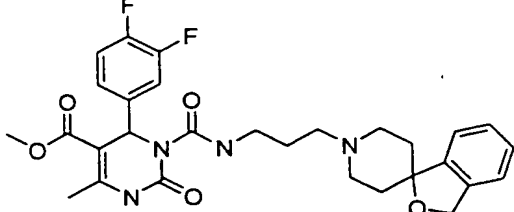
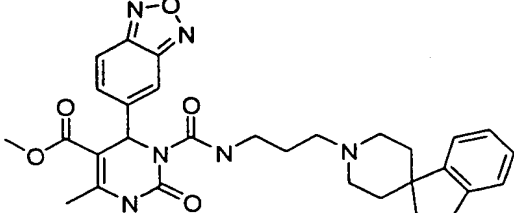
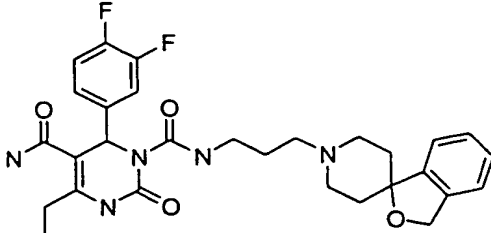
The compounds of Examples 1-37 were assayed using the cloned human MCH1 receptor. The preferred compounds were found to be selective MCH1 antagonists. The results are summarized in Table 1.

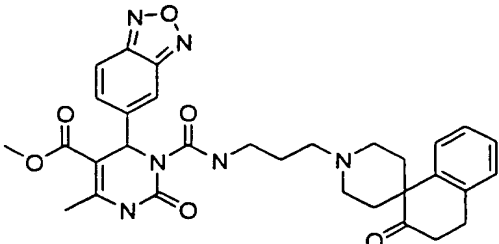
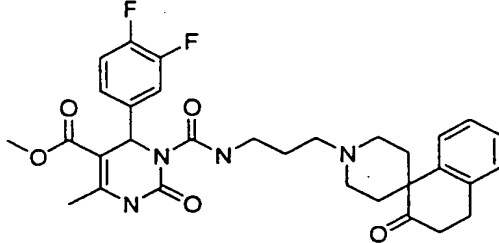
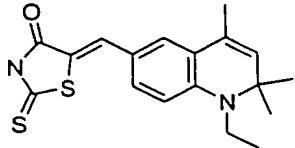
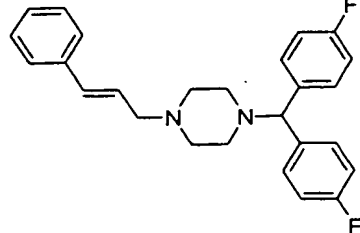
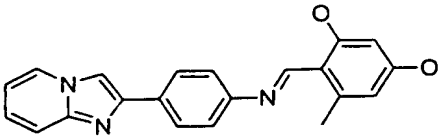
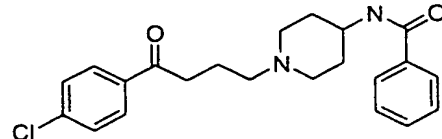
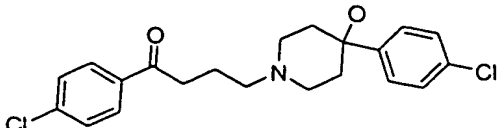
Table 1

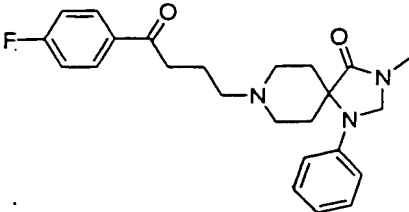
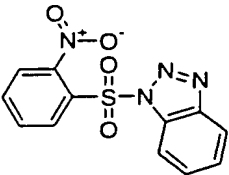
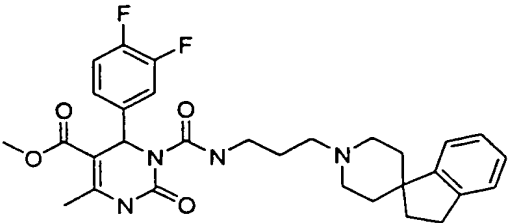
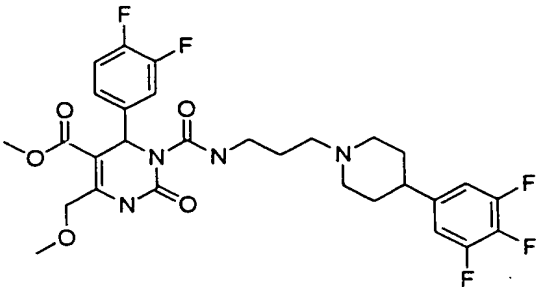
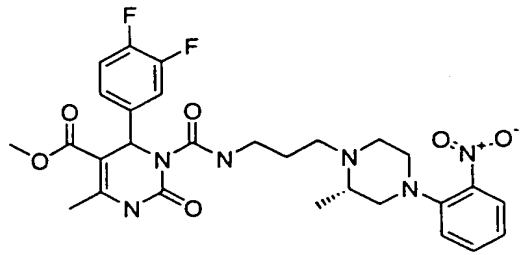
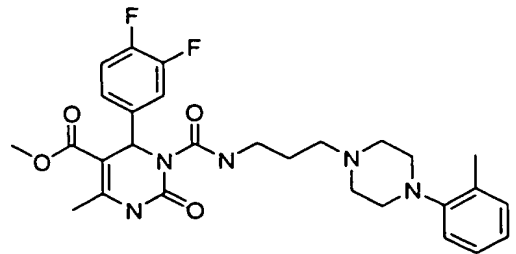
EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
1		42
2		18
3		201
4		187
5		258
6		42

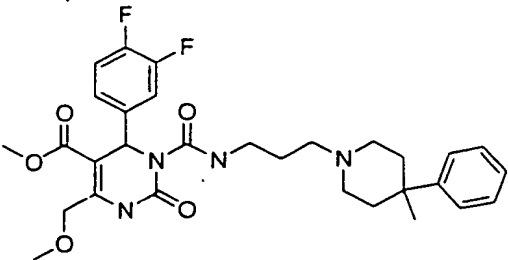
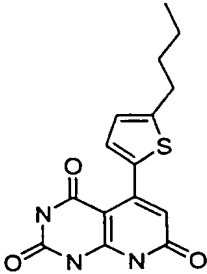
EXAMPLE No.	STRUCTURE	Kb (nM) hMCH1
7		41
8		88
9		35
10		0.3
11		331

EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
12		29
13		284
14		2
15		289
16		329

EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
17		373
18		1
19		7
20		5
21		28
22		40

EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
23		68
24		102
25		126
26		260
27		279
28		60
29		9

EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
30		479
31		7
32		67
33		12
34		182
35		276

EXAMPLE No.	STRUCTURE	K _b (nM) hMCH1
36		406
37		162

Radioligand Binding Assay Results

5 The compounds of Examples 1 to 37 were assayed using cloned human MCH1, NPY1, NPY5, GALR1, GALR2, and GALR3 and rat 5-HT2C receptors. The binding affinities of several compounds are shown in Tables 2 and 3.

The compounds of Examples 38 to 56 were assayed using the cloned rat MCH1 receptor. The binding affinities (K_i) of these compounds are shown in Table 4.

Table 2: Antagonist potency (Kb) at the human MCH1 receptor, and binding affinity (Ki) at NPY, galanin and 5HT2C receptors.

Compound	hMCH1	hNPY1	hNPY5	hGALR1	hGALR2	hGALR3	r5HT2C
	Kb (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)
10	0.3	>50000	>50000	>50000	>50000	>50000	29,585
18	1	>50000	>50000	>50000	>50000	>50000	32,617
14	2	ND	ND	>50000	42,603	>50000	663
20	5	27,076	>50000	>50000	>50000	>50000	15,058
19	7	>50000	>50000	>50000	>50000	>50000	11,720
29	9	>50000	46,075	>50000	>50000	>50000	>50000
2	18	ND	ND	>50000	>50000	>50000	39,837
6	42	6,667	4,735	11,057	14,921	21,095	25,549
1	42	>50000	>50000	>50000	>50000	>50000	>50000
28	60	>50000	>50000	>50000	>50000	>50000	34,087
25	126	>50000	>50000	>50000	>50000	>50000	41,009
37	162	>50000	>50000	>50000	>50000	>50000	>50000
4	187	>50000	>50000	>50000	>50000	>50000	34,798
26	260	>50000	>50000	>50000	>50000	>50000	2,900
27	279	>50000	>50000	>50000	>50000	>50000	>50000
13	284	9,601	>50000	11,262	4,727	5,985	25,030
30	479	>50000	>50000	>50000	>50000	>50000	8,859

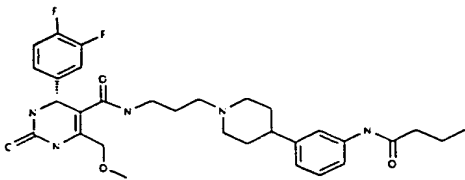
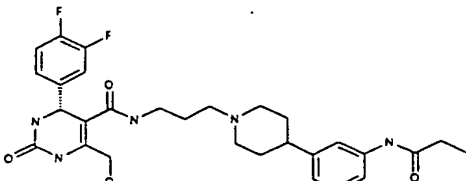
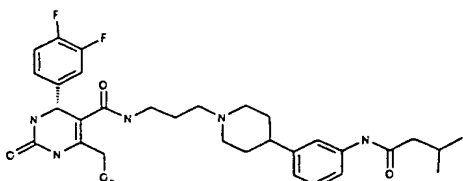
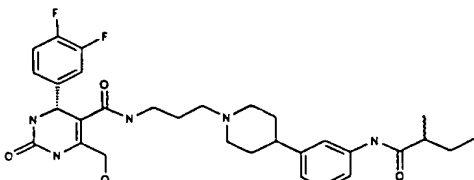
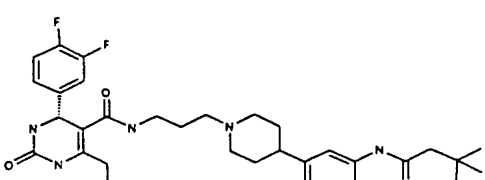
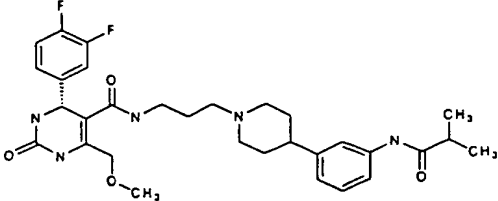
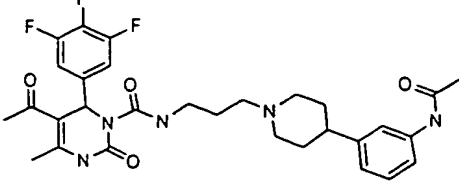
Table 3: Antagonist potency (Kb) at the human MCH1 receptor, and binding affinity (Ki) at human MCH1, NPY1, NPY5, GALR1, GALR2, GALR3, and rat 5HT2C receptors.

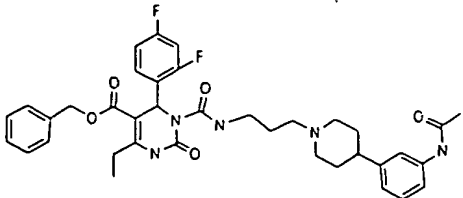
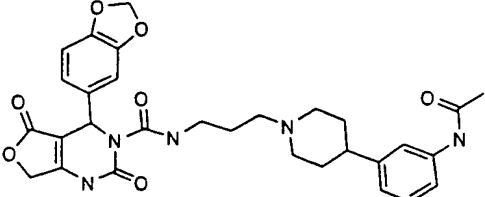
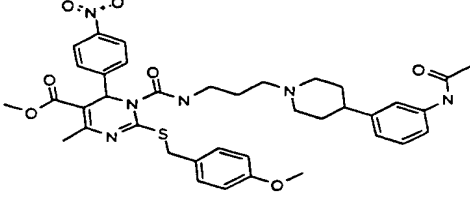
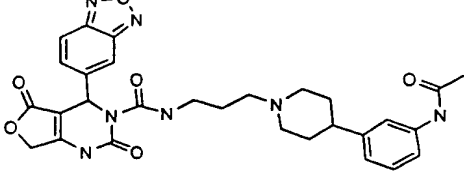
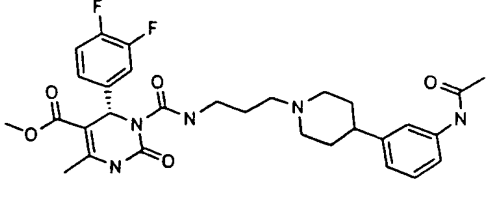
Compound	hMCH1	hMCH1 *	hNPY1	hNPY5	hGALR1	hGALR2	hGALR3	r5HT2C
	Kb (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)	Ki (nM)
10	0.3	0.08	>50000	>50000	>50000	>50000	>50000	29,585
19	7	3	>50000	>50000	>50000	>50000	>50000	11,720
18	1	4	>50000	>50000	>50000	>50000	>50000	32,617
20	5	6	27,076	>50000	>50000	>50000	>50000	15,058
1	42	40	>50000	>50000	>50000	>50000	>50000	>50000
2	18	49	ND	ND	>50000	>50000	>50000	39,837
14	2	50	ND	ND	>50000	42,603	>50000	663
4	187	131	>50000	>50000	>50000	>50000	>50000	34,798
13	284	171	9,601	>50000	11,262	4,727	5,985	25,030
29	9	350	>50000	46,075	>50000	>50000	>50000	>50000
6	42	463	6,667	4,735	11,057	14,921	21,095	25,549

* Binding affinity (Ki) was determined in competition binding assays using membrane preparations of A293 cells expressing the human MCH1 receptor and [³H]Compound 10 as the radioligand.

Table 4

EXAMPLE No.	STRUCTURE	Ki (nM) rMCH1
38		1.34
39		3.33
40		2.72
41		0.04
42		0.6
43		0.23
44		0.09

45		14.69
46		8.16
47		34.28
48		22.15
49		225.47
50		13.74
51		0.79

52		0.81
53		50.76
54		29.87
55		203.74
56		0.26

REFERENCES

- 5 Auburger, G., et al., (1992) Assignment of the second
(cuban) locus of autosomal dominant cerebellar ataxia to
chromosome 12q23-24.1, between flanking markers D12S58 and
PLA2. *Cytogenet. Cell. Genet.* 61:252-256.
- 10 Bahjaoui-Bouhaddi, M., et al., (1994) Insulin treatment
stimulates the rat melanin-concentrating hormone-producing
neurons. *Neuropeptides* 24:251-258.
- Baker, B.I. (1991) Melanin-concentrating hormone: a general
vertebrate neuropeptide. *Int. Rev. Cytol.* 126:1-47.
- 15 Baker, B.I. (1994) Melanin-concentrating hormone update:
functional consideration. *TEM* 5:120-126.
- Bassett, A.S., et al., (1988) Partial trisomy chromosome 5
cosegregating with schizophrenia. *Lancet* 1:799-801.
- 20 Bittencourt, J.C., et al., (1992) The melanin-concentrating
hormone system of the rat brain: An immuno- and
hybridization histochemical characterization. *J. Comp.*
Neurol. 319:218-245.
- 25 Burgaud, J.L., et al., (1997) Melanin-concentrating hormone
binding sites in human SVK14 keratinocytes.
Biochem.Biophys.Res.Comm. 241(3):622-629.
- 30 Craddock, N., et al., (1993) The gene for Darier's disease
maps to chromosome 12q23-q24.1. *Hum. Mol. Genet.* 2:1941-
1943.
- Drozd, R. and Eberle, A.N. (1995) Binding sites for

melanin-concentrating hormone (MCH) in brain synaptosomes and membranes from peripheral tissues identified with highly tritiated MCH. *J. Recept. Signal. Transduct. Res.* 15(1-4):487-502.

5

Drozdz, R., et al., (1995) Melanin-concentrating hormone binding to mouse melanoma cells in vitro. *FEBS* 359:199-202.

10

Drozdz, R., et al., (1998) Characterization of the receptor for melanin-concentrating hormone on melanoma cells by photocrosslinking. *Ann. NY Acad. Sci.* 839(1):210-213.

15

Gilliam, T.C., et al., (1989) Deletion mapping of DNA markers to a region of chromosome 5 that cosegregates with schizophrenia. *Genomics* 5:940-944.

20

Gonzalez, M.I., et al., (1997) Stimulatory effect of melanin-concentrating hormone on luteinizing hormone release. *Neuroendocrinology* 66(4):254-262.

25

Gonzalez, M.I., et al., (1997) α -melanocyte-stimulating hormone (α -MSH) and melanin-concentrating hormone (MCH) modify monoaminergic levels in the preoptic area of the rat. *Peptides* 18:387-392.

30

Gonzalez, M.I., et al., (1996) Behavioral effects of α -melanocyte-stimulating hormone (α -MSH) and melanin-concentrating hormone (MCH) after central administration in female rats. *Peptides* 17:171-177.

35

Grillon, S., et al., (1997) Exploring the expression of the melanin-concentrating hormone messenger RNA in the rat lateral hypothalamus after goldthioglucose injection. *Neuropeptides* 31(2):131-136.

- Habert-Ortoli, E., et al., (1994) Molecular cloning of a functional human galanin receptor. *Proc Natl Acad Sci USA* 91:9780-9783.
- 5 Herve, C. and Fellmann, D. (1997) Changes in rat melanin-concentrating hormone and dynorphin messenger ribonucleic acids induced by food deprivation. *Neuropeptides* 31(3):237-242.
- 10 Hervieu, G., et al., (1996) Development and stage-dependent expression of melanin-concentrating hormone in mammalian germ cells. *Biology of Reproduction* 54:1161-1172.
- 15 Julius, D., et al., (1988) Molecular characterization of a functional cDNA encoding the serotonin 1c receptor. *Science* 241:558-564.
- 20 Kawachi, H., et al., (1983) Characterization of melanin-concentrating hormone in chum salmon pituitaries. *Nature* 305:321-333.
- 25 Knigge, K.M., et al., (1996) Melanotropic peptides in the mammalian brain: The melanin-concentrating hormone. *Peptides* 17:1063-1073.
- 30 Knigge, K.M. and Wagner, J.E. (1997) Melanin-concentrating hormone (MCH) involvement in pentylenetetrazole (PTZ)-induced seizure in rat and guinea pig. *Peptides* 18(7):1095-1097.
- 35 Larhammar, D., et al., (1992) Cloning and functional expression of a human neuropeptide Y/peptide YY receptor of the Y1 type. *J Biol Chem.* 267:10935-10938.
- Ludwig, D.S., et al., (1998) Melanin-concentrating hormone:

a functional melanocortin antagonist in the hypothalamus.
Am. J. Physiol. Endocrinol. Metab. 274(4):E627-E633.

5 MacKenzie, F.J., et al., (1984) Evidence that the
dopaminergic incerto-hypothalamic tract has a stimulatory
effect on ovulation and gonadotropin release.
Neuroendocrinology 39:289-295.

10 McBride, R.B., et al., (1994) The actions of melanin-
concentrating hormone (MCH) on passive avoidance in rats:
A preliminary study. *Peptides* 15:757-759.

15 Melki, J., et al., (1990) Gene for chronic proximal spinal
muscular atrophies maps to chromosome 5q. *Nature* (London)
344:767-768.

Miller, C.L., et al., (1993) α -MSH and MCH are functional
antagonists in a CNS auditory paradigm. *Peptides* 14:1-10.

20 Nahon, J.L., et al., (1989) The rat melanin-concentrating
hormone mRNA encodes multiple putative neuropeptides
coexpressed in the dorsolateral hypothalamus. *Endocrinology*
125:2056-2065.

25 Nahon, J-L. (1994) The melanin-concentrating hormone: from
the peptide to the gene. *Critical Rev. in Neurobiol*
22:221-262.

30 Parkes, D.G. (1996) Diuretic and natriuretic actions of
melanin concentrating hormone in conscious sheep. *J.*
Neuroendocrinol. 8:57-63.

35 Pedeutour, F., et al., (1994) Assignment of the human pro-
melanin-concentrating hormone gene (PMCH) to chromosome
12q23-24 and two variant genes (PMCHL1 and PMCHL2) to

chromosome 5p14 and 5q12-q13. *Genomics* 19:31-37.

5 Presse, F., et al. (1992) Rat melanin-concentrating hormone messenger ribonucleic acid expression: marked changes during development and after stress and glucocorticoid stimuli. *Endocrinology* 131:1241-1250.

10 Qu, D., et al. (1996) A role for melanin-concentrating hormone in the central regulation of feeding behaviour. *Nature* 380:243-247.

15 Rossi, M., et al., (1997) Melanin-concentrating hormone acutely stimulates feeding, but chronic administration has no effect on body weight. *Endocrinology* 138:351-355.

20 Sahu, A. (1998) Evidence suggesting that galanin (GAL), melanin-concentrating hormone (MCH), neurotensin (NT), proopiomelanocortin (POMC) and neuropeptide Y (NPY) are targets of leptin signaling in the hypothalamus. *Endocrinology* 139(2):795-798.

25 Sakurai, T., et al., (1998) Orexins and orexin receptors: A family of hypothalamic neuropeptides and G protein-coupled receptors that regulate feeding behavior. *Cell* 92:573-585.

30 Sanchez, M., et al., (1997) Melanin-concentrating hormone (MCH) antagonizes the effects of α -MSH and neuropeptide E-I on grooming and locomotor activities in the rat. *Peptides* 18:393-396.

35 Sherrington, R., et al., (1988) Localization of a susceptibility locus for schizophrenia on chromosome 5. *Nature (London)* 336:164-167.

Smith. K.E., et al., (1998) Cloned human and rat galanin GALR3 receptors. Pharmacology and activation of G-protein inwardly rectifying K⁺ channels. *J Biol Chem* 273:23321-23326.

5

Smith, K.E., et al. (1997) Expression cloning of a rat hypothalamic galanin receptor coupled to phosphoinositide turnover. *J Biol Chem* 272:24612-24616.

10

Twells, R., et al., (1992) Chromosomal assignment of the locus causing olivo-ponto-cerebellar atrophy (SCA2) in a cuban founder population. *Cytogenet. Cell. Genet.* 61:262-265.

15

Westbrook, C.A., et al., (1992) Report of the second international workshop on human chromosome 5 mapping. *Cytogenet. Cell. Genet.* 61:225-231.